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TRANSCRIPT OF RECORD

Supreme Court of the United States

OCTOBER TERM, 1935

No. 758

INTERNATIONAL BUSINESS MACHINES CORPORATION, APPELLANT,

vs.

THE UNITED STATES OF AMERICA

APPEAL FROM THE DISTRICT COURT OF THE UNITED STATES FOR THE SOUTHERN DISTRICT OF NEW YORK

FILED FEBRUARY 12, 1936.

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IN UNITED STATES DISTRICT COURT FOR THE SOUTHERN DISTRICT OF NEW YORK

In Equity. No. 66/215

THE UNITED STATES OF AMERICA, Petitioner,

v.

INTERNATIONAL BUSINESS MACHINES CORPORATION, REMINGTON RAND INC., The Tabulating Machine Company, and Remington Rand Business Service, Inc., Defendants

PETITION

The United States of America, by George Z. Medalie, United States Attorney for the Southern District of New York, acting under the direction of the Attorney General, files this petition in equity against the above-named defendants and for cause of action alleges:

1. This petition is filed and the jurisdiction of the court invoked to obtain equitable relief against the defendants because of their violation jointly and severally, as hereinafter alleged, of the anti-trust laws of the United States.

2. The defendant, International Business Machines Corporation, hereinafter referred to as International Company, [fol. 3] is a corporation organized and existing under the laws of the State of New York and has a principal office and transacts business in the Southern District of New York.

3. The defendant, The Tabulating Machine Company, hereinafter referred to as Tabulating Company, is a corporation organized and existing under the laws of the State of New Jersey and has an office and transacts business in the Southern District of New York.

4. The defendant, Remington Rand Inc., hereinafter referred to as Remington Rand, and the defendant, Remington Rand Business Service, Inc., hereinafter referred to as Remington Business Service, are corporations organized and existing under the laws of the State of Delaware, and each has an office and transacts business in the Southern District of New York.

5. During the period covered by this petition International Company has owned all or substantially all of the capital stock of Tabulating Company and by means of said stock ownership has dominated, controlled, and directed, and still dominates, controls, and directs, the business affairs, policies, and activities of Tabulating Company, especially in respect of the subject matter of this petition and of the allegations herein contained.

6. During the period covered by this petition Remington Rand has owned all, or substantially all, of the capital stock of Remington Business Service, and by means of said stock [fol. 4] ownership has dominated, controlled, and directed, and still dominates, controls, and directs, the business affairs, policies, and activities of Remington Business Service, especially in respect of the subject matter of this petition and of the allegations herein contained. Throughout said period Remington Business Service has acted as an agent for the sale or lease of products manufactured by Remington Rand, including tabulating machines and tabulating cards.

7. Tabulating Company and Remington Rand have been for several years and now are engaged in the business of manufacturing machines and mechanical devices for tabulating, computing, and recording statistical information. Such machines and mechanical devices are referred to herein as tabulating machines.

8. Petitioner has heretofore manufactured a small number of tabulating machines for its own use which have been used by it in the Bureau of the Census; but all tabulating machines now manufactured and leased commercially in the United States are manufactured and leased by Tabulating Company or Remington Rand, and said defendants or their predecessors have made and now own substantially all of the more than 20,000 tabulating machines which are being used in the United States by numerous business concerns and by various departments, bureaus, and administrative establishments of petitioner, United States of America. [fol. 5] Approximately 88% of all said machines are owned by Tabulating Company and approximately 12% by Remington Rand.

9. Because of the increasing volume and complexity of the statistical data which the petitioner and many individ-

uals, partnerships, and corporations are required by modern methods of business organization to assemble, classify, and tabulate, and, further, because of the excessive cost of performing the mechanical operations required for such purposes when each separate act involved in the making, sorting, classification, and tabulation of such data is performed by hand, tabulating machines have become and now are a practical business necessity for the petitioner and for many such individuals, partnerships, and corporations.

10. In order to tabulate or record statistical facts and other data by means of tabulating machines, cards, referred to herein as tabulating cards, are first perforated by certain tabulating machines known as punches. The perforations indicate numerical or other data by their several locations or by their respective positions in relation to each other. Thereafter the sorting, tabulation, computation, recording, or other desired arrangement or classification of the statistical facts and other data contained on the tabulating cards is effected by passing the tabulating cards through the various mechanical or electrical processes of the tabulating machines.

[fol. 6] 11. Tabulating Company and Remington Rand have been for several years and now are engaged in the business of manufacturing tabulating cards, and in recent years have manufactured approximately 2,000,000,000 such cards annually.

12. Tabulating cards are manufactured from special varieties of paper or light cardboard, are necessary accessories or supplies required for the useful operation of tabulating machines, and are purchased or otherwise dealt in only for use in connection with tabulating machines.

13. The processes, formulæ, and other methods and means of manufacturing tabulating cards and the special varieties of paper or light cardboard from which tabulating cards are manufactured are not the subject of any letters patent of the United States, the cards embody no patented features, and anyone may manufacture such cards and sell them for use in tabulating machines without infringing any United States patent.

14. For many years the defendants have been and now are engaged (1) in leasing large numbers of tabulating ma-

chines and selling large quantities of tabulating cards to users of tabulating machines; (2) in shipping such machines and cards between different States of the United States; and (3) in delivering such machines and cards in interstate commerce to lessees or purchasers thereof located in the State of New York, including the Southern District of New York, and in various other States of the United States.

[fol. 7] 15. Commencing some time prior to March, 1931, and continuously since that time, Tabulating Company, International Company, and Remington Rand engaged in and have since continued to participate in a combination and conspiracy to restrain trade and commerce among the several States in the leasing and shipment of tabulating machines and in the sale and shipment of tabulating cards, and to monopolize such trade and commerce, in the manner and by the means hereinafter alleged. Remington Business Service has acted as the agent for Remington Rand in leasing tabulating machines and in selling tabulating cards pursuant to the terms of said combinations and conspiracy, and has been a party thereto.

16. On or about March 4, 1931, Tabulating Company and Remington Rand entered into a written agreement, a copy of which is annexed hereto, made a part hereof, and marked "Exhibit 1," by which the said parties agreed in substance and effect, subject to certain territorial limitations as to foreign trade, that (1) each should license the other under all its patents relating to tabulating machines; (2) neither party should sell, but should only rent or lease, tabulating machines; (3) neither party should rent or lease tabulating machines at less than the rentals, or sell tabulating cards at less than the prices, set forth in an exhibit attached to the agreement, which minimum rentals and minimum sales prices Tabulating Company might change, upon six months' [fol. 8] prior notice to Remington Rand, by not more than 10% above or below those set forth in said exhibit; (4) so long as it might be lawful so to do, neither party should rent any tabulating machine except upon condition that the lessee will purchase tabulating cards from its lessor at prices not less than those fixed by the agreement, or, in the alternative, that if such lessee uses other cards in connection therewith, it shall pay the cost of repair and maintenance of such leased machine in addition to and above the prevailing rental for such machine; (5) both parties should use their

best endeavor to promote the sale of their respective cards to their respective lessees and not to promote (so far as they may legally do so) the sale to their respective lessees of cards manufactured by others; (6) neither party should solicit any card business from a lessee of the other in the United States or Canada unless such lessee uses the machines of both parties; and (7) the agreement should continue until March 4, 1936. For the full terms and conditions of this agreement reference is made to Exhibit 1.

17. On March 4, 1931, International Company executed an instrument, a copy of which is annexed hereto, made a part hereof, and marked "Exhibit 2," by which it assented to the foregoing agreement of March 4, 1931, beween Tabulating Company and Remington Rand, and covenanted and agreed on behalf of itself and of its subsidiary and controlled com-[fol. 9] panies (including Tabulating Company) that they would be bound by the terms, covenants, and conditions of said agreement. For the full terms and conditions of said instrument reference is made to Exhibit 2.

18. When Tabulating Company and Remington Rand entered into the foregoing agreement of March 4, 1931, each of said companies owned competing patents relating to tabulating machines, and no efficient tabulating machine could be manufactured, leased, or sold in the United States except by said defendants without infringing either patents owned by Tabulating Company or patents owned by Remington Rand. By said agreement Tabulating Company and Remington Rand cross-licensed each other under their competing patents relating to tabulating machines for the purpose of eliminating competition between themselves in the leasing of tabulating machines and extending by combination the scope of their individual patent monopolies. The parties to said agreement, by agreeing to exercise unitedly their individual patent monopolies, combined to monopolize and restrain interstate commerce in tabulating machines.

19. Pursuant to the terms and provisions of the foregoing agreement of March 4, 1931, between Tabulating Company and Remington Rand, the defendants have entered into, and they are now entering into, various written agreements (denominated leases, licenses, or agreements for tabulating-[fol. 10] machine service) whereby tabulating machines are leased or licensed to numerous partnerships and corpora-

tions, as well as to different departments, bureaus, and administrative establishments of the petitioner, all of which lessees or licensees are herein referred to as machine users.

20. All said written agreements entered into by Tabulating Company provide in substance and effect, among other things, that (1) the company reserves title to the tabulating machines covered by the agreement; (2) the machine user acquires only the right to possess and a license to use said machines; (3) the machine user shall use in connection with said machines only tabulating cards manufactured by the company; and (4) the machine user shall pay to the company a monthly rental. Except in the case of agreements with the petitioner, said agreements permit Tabulating Company forthwith to resume possession of said machines if the machine user fails to observe the covenant to purchase tabulating cards for use in said machines exclusively from Tabulating Company. Said written agreements with petitioner provide that if the petitioner shall use in said machines tabulating cards not purchased from or manufactured by Tabulating Company, the monthly rental shall be increased in a large and substantial amount.

21. All said written agreements entered into by Remington Rand or Remington Business Service provide in sub- [fol. 11] stance and effect, among other things, that (1) the lessee acquires no title to the leased tabulating machines; (2) in cities where the lessor has an office, or headquarters of a representative, the lessor shall keep the said machines in working order and make all necessary repairs except those occasioned by the lessee's negligence; (3) if the lessee uses with said machines any tabulating cards which have not been purchased from the lessor, the lessee shall pay the cost of repairing and maintaining the machines; (4) the lessor may terminate the lease at any time for failure of the lessee to comply with any of its terms and conditions; and (5) the lessee shall pay to the lessor a monthly rental. Said written agreements with petitioner provide that if the petitioner shall use in said machines tabulating cards not purchased from the lessor, the monthly rental shall be increased in a large and substantial amount.

22. Defendants have at all times since March 4, 1931, refused to lease or license tabulating machines except upon

said terms and conditions, including those which directly or indirectly require machine users not to purchase or use tabulating cards of a competitor of the lessor or licensor except by incurring special obligations or paying excessive and noncompensatory additional rental, in the nature of a penalty. Because of these terms and conditions which the defendants have, by agreement between themselves, im- [fol. 12] posed upon all those who desired to use tabulating machines, the defendants have restrained and prevented each machine user, except the petitioner, from purchasing tabulating cards except from its lessor; and the defendants have by means of said unlawful terms and conditions collected from the petitioner large and substantial additional rentals.

23. By the foregoing means and methods the defendants have combined and conspired to monopolize, and have monopolized and attempted to monopolize, the interstate leasing and shipment of tabulating machines and the interstate sale and shipment of tabulating cards, and have combined and conspired to restrain all competition between themselves in said interstate commerce and to restrain the interstate commerce of others in tabulating cards, in violation of the Act of Congress of July 2, 1890 (26 Stat. 209), known as the Sherman Antitrust Act.

24. By the foregoing means and methods the defendants have leased tabulating machines for use within the United States and fixed the price charged therefor, or discount from or rebate upon such price, on the condition, agreement, or understanding that the lessee thereof shall not use or deal in tabulating cards of any competitor of its lessor, with the effect of substantially lessening competition and tending to create a monopoly in interstate commerce in [fol. 13] tabulating cards, in violation of the Act of Congress of October 15, 1914 (38 Stat. 730), known as the Clayton Act.

Wherefore petitioner prays:

That writs of subpœna issue directed to each defendant commanding said defendant to appear and answer under oath the allegations of this petition, and to abide by and perform such orders and decrees as the court may make in the premises;

And, further, that the court order, adjudge, and decree as follows:

That the combination, conspiracy, and agreements between the defendants described in this petition, including those intended to require or induce every lessee of a tabulating machine to purchase tabulating cards exclusively from its lessor constitute a conspiracy to restrain and to monopolize interstate trade and commerce, and constitute a monopolization of and an attempt to monopolize interstate trade and commerce, and are illegal and in violation of the Act of Congress approved July 2, 1890, known as the Sherman Antitrust Act;

That the defendants and each of them, and each and all of their respective officers, directors, agents, employees, and all persons acting or claiming to act on behalf of them, or any of them, be perpetually enjoined, individually and collectively, from further engaging in, agreeing to perform, or in fact performing, said conspiracy and monopoly or any [fol. 14] part thereof, or any other conspiracy or monopoly of like character or effect;

That all provisions in the leases or licenses of tabulating machines made by the defendants, or any of them, on the condition, agreement, or understanding that the machine user shall not use or deal in tabulating cards of a competitor of its lessor, and all provisions of every such lease or license which fix the rental, or discount from or rebate upon the rental, on such condition, agreement, or understanding, as described in this petition, are illegal and null and void and in violation of the Act of Congress approved October 15, 1914, known as the Clayton Act;

That the defendants and each of them, and each and all of their respective officers, directors, agents, employees, and all persons acting or claiming to act on behalf of them, or any of them, be perpetually enjoined, individually and collectively, from further making or enforcing any of the above-described illegal provisions in leases or licenses of tabulating machines, or any other provision in such a lease or license of like character or effect;

That within thirty days of the entry of a final decree herein each defendant shall openly abrogate, cancel, and declare to be null and void any and all provisions in every outstanding lease or license of a tabulating machine made [fol. 15] by it which shall by any decree entered herein be adjudged to be null and void, and shall thereupon furnish

to each user of its tabulating machines a formal notice in writing of such abrogation and cancellation.

That the petitioner have such other, further, general, and different relief as the nature of the case may require and the court may deem proper in the premises.

That the petitioner recover its taxable costs.

George Z. Medalie, United States Attorney for the Southern District of New York. William D. Mitchell, The Attorney General. John Lord O'Brian, The Assistant to the Attorney General. Russell Hardy, Charles H. Weston, Jas. Maxwell Fassett, Special Assistants to the Attorney General.

[fol. 16] *Duly sworn to by Jas. Maxwell Fassett. Jurat omitted in printing.*

[fol. 17] EXHIBIT 1 TO PETITION

Agreement made in duplicate this 4th day of March, 1931, between The Tabulating Machine Company, a corporation of New Jersey (hereinafter called "Tabulating Company"), and Remington Rand Inc., a corporation of Delaware (hereinafter called "Remington Rand");

Whereas, Tabulating Company is the owner of patents and applications for patents of the United States and certain foreign countries which relate to sorting and tabulating machines the inventions of some of which it believes Remington Rand is now using; and,

Whereas, Remington Rand is the owner of patents and applications for patents relating to the same subject-matter the inventions of some of which it believes Tabulating Company is now using; and,

Whereas, Tabulating Company entered into a certain written agreement with Powers Accounting Machine Corporation, a corporation of the State of Delaware, dated August first, 1922, and Remington Rand has become the owner of the assets and going business of said Powers Corporation; as to which agreement certain disputes have arisen between Tabulating Company and Remington Rand with respect to the amount of monies claimed by Tabulating Company as being payable thereunder; and,

Whereas, Tabulating Company and Remington Rand have been and now are involved in certain litigations with [fol. 18] respect to patents and patented inventions; and,

Whereas, Remington Rand is desirous of acquiring a license under Tabulating Company's patents aforesaid and patents and inventions hereafter to be issued to or acquired by Tabulating Company to the extent and in the manner hereinafter specified, and Tabulating Company is desirous of acquiring the right to use present and future patents and inventions of Remington Rand to the extent and in the manner hereinafter specified; and both parties are desirous of settling the disputes and litigations aforesaid, and of discharging all liabilities and obligations which may have arisen or might hereafter arise under said agreement of August 1st, 1922, and of avoiding as far as possible future controversies over patented inventions:

Now, therefore, in consideration of the terms and conditions herein and for other good and valuable considerations, the receipt whereof is hereby acknowledged the parties have agreed and by these presents do agree as follows:

Definitions

A "sorting machine" or "sorter" is a machine for separating, sorting, or re-sorting cards into groups.

A "tabulating machine" or "tabulator" is a machine for deriving data from cards under the actuation or control of perforations or marks, therein or thereon, and for assembling, and/or calculating, and/or recording such derived data.

"Hollerith" is used to indicate the "electric" style of machine (whether tabulator or sorter) that has been de- [fol. 19] veloped by Tabulating Company, as the same may be modified or improved, and in which the machine is controlled as to its differential action for tabulating, calculating and/or sorting, by electric circuits which generally are completed under the control of a mark or hole on or in the card.

"Powers" is used to indicate the "mechanical" style of machine (whether tabulator or sorter) that has been developed by the predecessor companies of Remington Rand Inc.; viz., Powers Accounting Machine Corporation, and its predecessors, as the same may be modified or improved, and in the differential action of which there are no electric

circuits completed under control of marks or perforations in the cards, but in which control of the machine as to its differential action for tabulating, calculating, and/or sorting is entirely mechanical under the direct control of the mark or hole in the card.

A "card" is a piece or strip of record material; for example, pasteboard, designed to be marked, punched or perforated with one or more marks or perforations, or to have one or more marks or index points placed thereon indicating numerical or other data by their several locations or relative positions, and to be utilized in the sorting or tabulating machines, or both.

License to Remington Rand

Tabulating Company for itself, its present and/or future affiliated and/or controlled companies, hereby grants to Remington Rand subject to the provisions and limitations [fol. 20] hereinafter set forth, each and all of which are conditions of such grant, a nonexclusive and indivisible license (except in Germany and the British Empire and its possessions outside of Canada) under all of the patents it or they now own or control directly or indirectly and under any patents that may hereafter issue to or which may be acquired by it or them during the term of this agreement, on or relating to tabulators and sorters, or parts thereof only for use in "Powers" tabulating machines and "Powers" sorting machines. Nothing herein contained shall be deemed to create in Remington Rand any license for the use of Tabulating Company's patents or any of them in machines in which the differential action for tabulating, calculating and/or sorting is controlled by one or by more than one electric circuits completed under the control of a hole or mark in the card.

Remington Rand agrees not to sell any such licensed tabulating or sorting machines for use in the United States and/or Canada, but only to rent or lease the same upon terms of rental not less than those stated in the schedule annexed hereto and marked "Exhibit A". Excepting, however, that Tabulating Company recognizes that Remington Rand has sold machines in Canada and has heretofore entered into certain agreements to lease machines in Canada with an option to the lessees thereof to purchase the same and agrees that Remington Rand shall have the

right (1) to fulfill such existing agreements, and (2) to sell other machines where required by customers in Canada who have heretofore purchased such machines, but in the case of the Canadian Government, each department or bureau shall be regarded as a separate customer.

[fol. 21] Cards

Remington Rand and Tabulating Company severally agree, each for itself, that so long as it may be lawful so to do they will not, in the United States or Canada, rent or lease any tabulating or sorting machines except on condition that the lessee thereof will purchase cards from the lessor thereof at not less than the prices stated in Schedule A hereto, or, in the alternative, that if such lessee does not use therewith cards purchased from such lessor the cost of repair or maintenance of such leased machine shall be charged against and paid by the lessee in addition to and above the prevailing rental for such machine; and Tabulating Company and Remington Rand severally agree to use their best and utmost endeavor to promote the sale of their respective cards to their respective users of punching, tabulating and/or sorting machines and not to promote (so far as they may lawfully do so) or to encourage directly or indirectly the sale to their respective lessees of cards manufactured by others. Tabulating Company and Remington Rand further severally agree each for itself that it will not solicit business from any such user of the other party in the United States or Canada for cards, unless such user is a user of machines of both parties.

License from Remington Rand to Tabulating Company

As a part consideration for the foregoing license Remington Rand does for itself, its present and/or future affiliated and/or controlled companies, hereby grant to Tabu-
[fol. 22] lating Company, subject to the provisions and limitations hereinafter set forth, each and all of which are conditions of such grant, a nonexclusive and indivisible license under all of the patents it or they now own or control directly or indirectly and under any patents that may hereafter issue to or which may be acquired by it or them during the term of this agreement, on or relating to tabulators or sorters, or parts thereof, only for use in "Hollerith"

tabulating and "Hollerith" sorting machines; except that no rights are granted hereby in Germany, Denmark, Spain, Portugal, Portuguese Africa, Argentine Republic, the British Empire and its dominions, colonies, dependencies and mandates, including Egypt (other than the dominions, colonies, dependencies and mandates of such British Empire in North America, Central America, the West Indies, South America and Hong Kong), to which this license does apply. Nothing herein contained shall be deemed to create in Tabulating Company any license for the use of Remington Rand's patents or any of them in machines in which the differential action for tabulating, calculating and/or sorting is entirely mechanical under the direct control of a hole or mark in the card.

Tabulating Company agrees only with respect to the United States and Canada, to lease and not to sell its tabulating and sorting machines coming under this agreement and to comply fully with the restrictions described in "Exhibit A" with reference to tabulating machines, sorting machines, the rental thereof, and the sale of cards.

Tabulating Company, however, reserves the right to change from time to time, in each instance on at least six (6) months' notice in writing to licensee, the minimum [fol. 23] rentals of tabulating machines or sorting machines shown in the annexed "Exhibit A", and to fix rentals upon any new types or classes of machines involving any of its patents coming under this agreement, and Tabulating Company also reserves the right from time to time upon like notice in writing to Remington Rand to change the minimum prices at which cards shall be sold, shown on the annexed "Exhibit A", but such changes in minimum rentals and prices shall not exceed in total or aggregate ten per cent. (10%) above or below those stated in "Exhibit A": Provided, however, that no such change in minimum rentals and/or card prices shall apply to any lease of either of the parties hereto in force at the time of giving any such notice.

Terms of Payment

Remington Rand agrees to pay to Tabulating Company, upon the execution and delivery of this agreement, the sum of Three Hundred and Fifty Thousand Dollars ($350,000.00); and the further sums of Twenty-five Thousand Dollars ($25,000.00) per year for five (5) years hereafter,

one of such further sums to be paid on each of five (5) successive anniversaries of the day of execution of this agreement.

Duration and Forfeiture

This agreement and the licenses hereunder shall continue in existence for the term of five (5) years from the date hereof and shall thereupon cease and determine, except as and to the extent hereinafter specifically provided. Provided, however, that Tabulating Company shall have the [fol. 24] right and option to terminate and cancel it upon failure of Remington Rand to make any of the annual payments of Twenty-five Thousand Dollars ($25,000.00) when due, or by thirty (30) days' notice in writing of the failure of Remington Rand to comply fully with the restrictions set forth in "Exhibit A" with reference to tabulating machines, sorting machines, the rentals thereof, and the sale of cards; and in the event of such termination all of the annual payments then unpaid shall forthwith become due and payable. And provided further that Remington Rand shall have the right and option to terminate and cancel it by thirty (30) days' notice in writing of the failure of Tabulating Company to comply fully with the restrictions set forth in "Exhibit A" with reference to tabulating machines, sorting machines, the rentals thereof, and the sale of cards; and in the event of such termination all of the annual payments then unpaid shall forthwith become due and payable.

The licenses granted hereunder are indivisible and unassignable; Provided, however, that each party hereto shall have the right to sell, assign and transfer its entire interest in this agreement to the successor of its entire business in tabulators and sorters.

It is further mutually agreed that upon the termination of this agreement at the end of five (5) years, each party shall thereafter have the right, notwithstanding any patent of the other party unexpired at the termination of this agreement, (a) to continue to lease or rent but not to sell in the United States and Canada any and all machines embodying any of such unexpired patents or pending applications which shall have been manufactured theretofore and [fol. 25] actually installed and put into use in accordance with the terms of this agreement, and (b) to continue to

manufacture for leasing or rental but not for sale machines of the same construction embodying any of such unexpired patents or pending applications [except as to the limited right of Remington Rand to sell in Canada as hereinbefore provided]. Provided, however, that such continuance of manufacture and leasing or rental shall be conditioned upon proof by the party so claiming it of its manufacture and the commercial use by a lessee or lessees of such party of at least twenty-five (25) machines embodying the construction involved continuously for a period of at least six (6) months prior to the end of said five (5) years.

Interferences

It is mutually agreed that all patent interference controversies now pending in the United States Patent Office and/or in the Federal Courts of the District of Columbia and Delaware and/or in the Court of Customs and Patent Appeals shall be terminated and settled, by proper concessions of priority or otherwise without further contest, upon the basis of the awards heretofore made by the tribunals of the Patent Office; the party in whose favor such award has been made, however, to give to the adverse party an irrevocable simple license as applied to such adverse party's machine as heretofore described, for the life of the patent, which or the application for which has been involved in such interference; and both parties hereto shall instruct their respective patent counsel forthwith to carry out this provision.

[fol. 26] Remington Rand and Tabulating Company further agree that in the event of future patent interferences being declared upon applications owned or controlled by the respective parties, such interferences shall be referred forthwith to the respective patent counsel of both parties with instructions to use their best endeavors to settle the same by concession and without contest in the Patent Office and/or Courts.

Miscellaneous

It is mutually and severally agreed that upon the execution and delivery of this agreement and the payment by Remington Rand of the aforesaid sum of Three Hundred and Fifty Thousand Dollars ($350,000.00), Remington Rand Inc. and/or Powers Accounting Machine Corporation

on the one hand, and Tabulating Machine Company on the other, shall be and remain severally released and forever discharged from any and all claims or demands of whatsoever kind or description, by reason of the conduct of any of the parties thereto, their successors or assigns, of the business in card punching, sorting and tabulating machines and cards prior to the date of this present agreement, arising out of said contract dated August 1, 1922, and the prior contract of July 22, 1914, between Tabulating Machine Company and the other parties thereto and/or the amendments thereto, and any understandings or agreements with respect or relating thereto, and from any claims or demands, by reason of any such conduct prior to the date of this agreement, arising out of or under any Letters Patent (except German Patents) owned or held by either of the [fol. 27] parties thereto and/or their affiliated, controlled or subsidiary companies and any and all demands or claims which may have arisen or might arise hereafter with respect to said contracts; and it is further agreed that the releases hereby given shall extend to all and every of the affiliated or controlled companies of the parties to said agreement of August 1, 1922, and of the parties to this agreement. Excepting, however, that it is expressly understood that nothing contained in this agreement shall release Remington Rand or its subsidiaries from royalties now or heretofore due or hereafter accruing to Deutsche Hollerith Machines Gesellschaft, a corporation of Germany subsidiary to or affiliated with Tabulating Company, with respect to certain license or licenses under patents of Germany known and designated as the Laurant and Hollerith patent licenses, which licenses are not affected by this agreement.

It is mutually and severally agreed that neither party hereto shall in conducting its business hereunder furnish free cards or free use of a machine of any kind whether tabulator, sorter or otherwise to a customer or prospective customer except for strictly demonstrating and educational purposes, or give any rebate, concession or consideration which would tend directly or indirectly to reduce the cost of cards and/or rentals of machines below those specified in "Exhibit A".

It is further mutually and severally understood and agreed that except as otherwise specifically provided hereinbefore, Tabulating and/or Sorting Machines if sold in

[fol. 28] the United States or Canada by either of the parties hereto shall not be considered as made, sold, used, or licensed under or by virtue of this agreement.

It is further mutually understood that, in the event of Remington Rand's devising or acquiring during the period of five (5) years from the date of this agreement a new type or types of tabulating and/or sorting machine not coming in whole or in part under any of the then existing patents or applications for patent of Tabulating Company, Remington Rand shall have the right to fix the minimum prices at which Tabulating Company shall rent or lease machines of such new type or types; Provided, however, that Remington Rand shall itself maintain and observe such minimum prices for its own rentals or leases.

In witness whereof, the parties have hereunto caused these presents to be executed in duplicate in their corporate names by their respective Presidents, and their corporate seals to be hereunto affixed and attested by their Secretaries, all the day and year first above written.

The Tabulating Machine Company, by Thos J. Watson, President.

Attest: J. G. Phillips, Secretary,

Remington Rand Inc., by W. F. Merrill, President.

Attest: William S. Adamson, Assistant Secretary.

[fol. 29] EXHIBIT "A" TO AGREEMENT

The following is the schedule of the minimum rentals made a part of the annexed License Agreement between The Tabulating Machine Company and Remington Rand Inc.

The minimum rentals for each Tabulating Machine and Sorting Machine shall be as follows, in all cases where the lessee agrees to purchase cards from the lessor:

Tabulating machines (Nonlisting and non-total-printing):

(a) For each machine with not more than 3 counters—Not less than $25.00 per month.

(b) For each machine with 4 counters—Not less than $30.00 per month;
(c) For each machine with 5 counters—Not less than $35.00 per month.

Tabulating machines (Total-printing):
Not less than $60.00 per month for each machine for numerical printing.

Tabulating machines (Listing and total-printing):
Not less than $75.00 per month for each machine for numerical printing;
Not less than $100.00 per month for each machine for alphabetical printing.

Sorting machines:
Noncounting—Not less than $20.00 per month;
Counting—Not less than $10.00 per month additional.

[fol. 30] The minimum prices for cards shall be as follows:

Size 7⅜" by 3¼", $1.00 per 1000.
Size 6⅝" by 3¼", 85 cents per 1000.
Size 6⅝" by 3¼", 70 cents per 1000.

Other sizes at proportionate prices.

[fol. 31] EXHIBIT 2 TO PETITION

International Business Machines Corporation, a corporation of the State of New York, being the owner of all of the capital stock of The Tabulating Machine Company, a corporation of the State of New Jersey, in consideration of Remington Rand Inc., a corporation of the State of Delaware, entering into an agreement on the 4th day of March, 1931, with the said The Tabulating Machine Company, a copy of which agreement is annexed hereto, hereby assents to and acquiesces in the execution by The Tabulating Machine Company of said agreement and covenants and agrees by and with Remington Rand Inc., that The Tabulating Machine Company will faithfully perform the obligations assumed by it in said agreement, and further covenants and agrees on behalf of itself and of its subsidiary and con-

trolled companies, that they will be bound by the terms, covenants and conditions of said agreement.

As to the grants or rights extended by said agreement from The Tabulating Machine Company, International Business Machines Corporation hereby acknowledges itself to be an affiliated grantor, as set forth therein, and further covenants and agrees on behalf of itself and its subsidiary and controlled companies to be bound by the terms of the mutual release clause contained in the paragraph headed "Miscellaneous" in said agreement.

[fols. 32 & 33] In witness whereof International Business Machines Corporation has hereunto caused these presents to be executed in its corporate name by its President, and its corporate seal to be hereunto affixed and attested by its Secretary, all on the 4th day of March, 1931.

International Business Machines Corporation, by Thomas J. Watson, President.

Attest: J. G. Phillips, Secretary.

[fol. 34] IN UNITED STATES DISTRICT COURT

[Title omitted]

ANSWER

The defendants, International Business Machines Corporation and The Tabulating Machine Company, by Davies, Auerbach & Cornell, their attorneys, answering the petition of the United States of America:

1. Admit the jurisdiction of the court but deny that these defendants jointly or severally have violated the anti-trust laws of the United States as alleged in paragraph 1 of the petition.

2. Admit the allegations set forth in paragraphs 2, 3, 5, 7, 11, 14 and 17.

[fol. 35] 3. Deny any knowledge or information sufficient to form a belief as to each and every allegation set forth in paragraph 6 of the petition.

4. Admit that petitioner has heretofore manufactured a small number of tabulating machines for its own use which

have been used by it in the Bureau of Census, as alleged in paragraph 8 of the petition, but deny each and every remaining allegation set forth in said paragraph, and allege that there are other different kinds of machines and mechanical devices for tabulating, computing and recording statistical information, manufactured and sold or leased commercially in the United States by others than the defendants herein, and in competition with them. These defendants further allege that the particular type of tabulating machines which are manufactured and leased by the defendant The Tabulating Machine Company and by the defendant Remington Rand, Inc. and its subsidiary companies operate by means of holes punched in cards, and that said defendants now own and have leased to others for use the tabulating machines of that type made by said defendants respectively or their predecessors.

5. Deny the allegations set forth in paragraph 9 of the petition that tabulating machines (as defined and intended in said petition) have become or are now a practical business necessity for the petitioner or other individuals, partnerships or corporations, and allege that there are a number of other machines upon the market made and sold or leased by others than the defendants herein, and in competition with them, which by various means and methods accomplish the same or similar results.

[fol. 36] 6. Deny each and every allegation set forth in paragraph 10 of the petition and allege that the punches referred to in said paragraph are not tabulating machines and further allege that the cards referred to in said paragraph actuate and control and are essential and component parts of the kind of tabulating machines manufactured and leased by the defendants.

7. Deny each and every allegation set forth in paragraph 12 of the petition and allege that the cards referred to in said paragraph are not accessories or supplies but are essential and component parts of the kind of tabulating machines manufactured and leased by defendants and are essential to the operation thereof.

8. Deny each and every allegation set forth in paragraphs 13, 15, 23 and 24 of the petition.

9. Admit that Tabulating Company and Remington Rand entered into the agreement "Exhibit 1" as alleged in para-

graph 16 of the petition, but deny that the terms thereof are accurately or completely set forth in said paragraph and beg leave to refer to the original when produced upon the trial, for such terms.

10. Deny each and every allegation set forth in paragraph 18 of the petition and allege that the agreement referred to in said paragraph was entered into in the settlement of claims and amounts due under prior agreements and to free each from claims of infringement by the other; that neither thereby exclusively licenses the other; that each is free to license others on any terms it pleases and that neither monopoly nor the elimination of competition nor the restraint of interstate commerce was intended, effected or in- [fol. 37] volved; that by such cross licensing competition was promoted between the parties, that prices were not controlled, and in fact the parties to such agreement or their predecessors had been, prior to the time of such agreement, and still are, competing with each other at prices substantially above the minimum prices set forth in Exhibit A, which prices so set forth in Exhibit A were not at or prior to the time of said agreement price levels on which said competitive business was in fact conducted; that business has not been done on any fixation of price; that the range of price at which the said defendants have competed with each other has always been and is above the minimum therein set forth, and that the terms of Exhibit A were and are reasonable and proper to the protection of the business of these defendants, and in reasonable protection of their patents and other property.

11. Admit, as to paragraph 19 of the petition, that these defendants have leased and not sold their tabulating machines for use in the United States; and on information and belief, that Remington Rand, Inc., and/or Remington Rand Business Service, Inc., have leased and not sold their tabulating machines for use in the United States; but aver that all of said parties defendant and their respective predecessors have done so since the beginning of their respective businesses.

12. Deny that the substance of the written agreements of Tabulating Company are accurately or completely set forth in paragraph 20 of the petition, and allege that the petition defines and uses the term tabulating machine erroneously

as including punches; that these defendants do not sell tabulating or sorting machines but do sell punches; that defend- [fol. 38] ants attach and make a part hereof a copy of one of their leases, marked Exhibit X, and a copy of their contract with the Department of Justice of the United States, marked Exhibit Y; that such leases are not, and never were, made except as reasonable regulations of Tabulating Company's business with its customers, under its patents and with respect to its leased machines.

13. These defendants are not sufficiently informed as to the written agreements entered into by Remington Rand, Inc., or Remington Rand Business Service, Inc., and therefore deny the averments contained in paragraph 21 of the petition.

14. Deny each and every allegation set forth in paragraph 22 of the petition except that defendants admit that the agreed-upon rentals of these defendants' tabulating machines, when leased under agreements such as Exhibit X hereto, are based upon the exclusive use in defendants' machines of cards manufactured or furnished by these defendants; that these defendants' contracts, such as Exhibit Y hereto made with petitioner, provide that if the petitioner herein uses cards manufactured by these defendants the rentals shall be reduced; that such contracts were after negotiation made with these defendants and in this respect differ from all other contracts of these defendants and are more favorable to the petitioner; that defendants have at all times and are ready and willing to enter into contracts with petitioner herein, as with others, without such provisions.

15. These defendants aver that they are the present owners of the entire right, title and interest in various Letters Patent of the United States and in the inventions and improvements set forth therein, as listed in Schedules A, B, C and D hereto attached and made a part hereof.

[fol. 39] That the patents in Schedule A are for inventions in tabulating machines; that the patents in Schedule B are for inventions in sorting machines; that the patents in Schedule C are for inventions in cards; that the patents in Schedule D are for inventions relating to the manufacture of cards; such tabulating, sorting machines and cards being, respectively, the machines and cards designated by such

names in Exhibit 1 and Exhibit A to the petition herein, and in Exhibits X and Y to this answer.

That on or prior to the respective filing dates of the several patents enumerated in the above Schedules A, B and C, each of the respective patentees was, within the meaning of the statutes of the United States then in force, and was found by the United States Patent Office to be, the true and original inventors of the certain new and useful inventions entitled as indicated in the above schedules; that the respective Letters Patent were issued in due form of law, in the name of the United States of America, under the seal of the United States Patent Office, signed by the Commissioner of Patents, duly recorded and delivered to these defendants or their assignors, and were so issued after due examination as to the novelty, patentability and utility of the respective inventions therein described, and upon payment of the fees required by law; and that the respective Letters Patent granted to these defendants or their assignors, and their legal representatives or assigns, for the full term of seventeen years from the respective dates of issuance thereof, the full and exclusive right to exclude others from making, using and selling the respective inventions set forth, described and claimed therein throughout the United States and the territories thereof.

[fol. 40] That as these defendants were and are advised and believe, The Tabulating Machine Company's tabulating and sorting machines, and cards, were and are, in whole or in part, embodiments of such inventions so patented.

That as these defendants are advised and believe, the defendant, Remington Rand, Inc., was and is the owner of other Letters Patent of the United States upon inventions in such tabulating and/or sorting machines as have been heretofore referred to; that such products of these defendants were charged to infringe upon certain of the patents of the defendant, Remington Rand, Inc., and that such products of Remington Rand, Inc., were infringements upon some of these defendants' patents; and that there existed between applications owned by these defendants and applications owned by Remington Rand, Inc., contests in the Patent Office as to priority of inventorship as between the respective applicants, such contests being designated interferences by the Patent Office.

To have litigated these various questions of infringement and interference would have involved years of delay and

possible large damages against one or the other party, and might have prevented the technical development of the machines of these defendants and Remington Rand, Inc., either or both.

That the agreement Exhibit 1 to the petition, was entered into in good faith for the purpose of adjusting and compromising the respective claims of each against the other, by which each granted immunity to the other for its operation, and the right of use of all inventions of the grantor in the machines of the type developed by the grantee. By this contract great delay, expensive litigations, uncertainty and confusion were avoided and the customers of each party, including the petitioner, received the [fol. 41] benefit of the settlement and the two parties to the contract were free to pursue their own operations and to compete freely each with the other.

16. That the tabulating and sorting machines of these defendants embodied some or all of the inventions and improvements set forth in the Letters Patent in Schedules A and B above; that they are machines requiring great skill for their construction, are made of a great multiplicity of parts, and are delicate and sensitive in operation; their performance of each operation is controlled by the closing of one or more electrical circuits through holes or perforations in cards; that each card as it goes through the machine is a component part thereof, and governs the proper actuation of selected parts and operative members of the machine; that great speed and accuracy are required of each machine in the ordinary performance of its functions; that any variation in size of the cards or in the position of the holes therein, or any foreign matter existing in the material of the cards tends not merely to cause wrong actuation of the machine and mistaken results or impressions therefrom, but also to injure the machine and to necessitate repairs thereof; that by their leasing contracts these defendants have assumed the expense of maintaining such machines in proper order and repair; that in order to insure the proper actuations of machines and their accurate performance for their customers, these defendants have been to great trouble and expense to attain perfection in the manufacture of the cards themselves, both as to the size

of the cards and the material of which they are made, and the methods of their manufacture and testing of card material; some of which are the subject of Letters Patent of the United States, as shown in Schedule D. That be- [fol. 42] cause of the accuracy required by the cards aforesaid and the necessity of maintaining the leased machines in good order and repair, these defendants require of all their lessees (except petitioner) that such lessees purchase their cards from defendant, The Tabulating Machine Company; and that such requirement is reasonable under the circumstances and does not tend unduly to suppress or restrict competition.

That these defendants make no effort or attempt in any way to control the supplies which are or may be used in connection with the said patented machines; that in the use of said machines put out, sold and leased by these defendants, there are a large number of different varieties of paper supplies, ribbons, &c., amounting in aggregate values to large sums of money annually which are not component parts of said machines, the sale of which these defendants make no attempt whatsoever to restrict or control. But that these defendants do attempt to control the cards which are or may be used as a component part of said machines for the reason: (1) That said cards are an essential component part of said machines; (2) that said cards are in certain cases covered by patents, and in other cases are covered by patents after being prepared to be used in defendants' machines, and (3) that in all cases for the minimization of expense of servicing, for the accuracy of the result and the satisfactory performance of the machines, and for the protection of defendants' reputation in respect of the machines, it is greatly to the advantage of the defendants and to the advantage of the users of the said machines that said cards used in the machines as a component part thereof shall be the cards furnished by these defendants and that the restriction to such use is the only way these defendants have of assuring to them- [fol. 43] selves and to their users, protection against the increased service expense and the unsatisfactory operating results of the machines which defendants anticipate and fear from cards supplied by others, lacking the requisite standard of perfection in quality, size and configuration.

That for many years petitioner, in leasing machines from The Tabulating Machine Company and its predecessors, entered into leasing agreements similar in terms to Exhibit X hereto; but that lately, in negotiating for the use of machines, petitioner refused to be bound to purchase cards from The Tabulating Machine Company, and that in such negotiations The Tabulating Machine Company and petitioner agreed upon the terms of Exhibit Y, as reasonable and proper, and not as calling for excessive or non-compensatory rental, or in the nature of a penalty.

17. That in the making of Exhibit 1 to the petition, these defendants insisted upon the inclusion of a like restriction as to cards, upon Remington Rand, Inc., as a reasonable protection to the business of these defendants and not for the purpose of illegally restraining trade or competition.

Davies, Auerbach & Cornell, for Defendants International Business Machines Corporation and The Tabulating Machine Company. Edward Cornell, Drury W. Cooper, Of Counsel.

[fols. 44 & 45] *Duly sworn to by Otto E. Braitmayer and L. H. La Motte. Jurats omitted in printing.*

[fol. 46] SCHEDULE "A" TO ANSWER

Inventor	Patent No.	Filing & Issue dates and Title or Subject of Patent
J. R. Peirce.....	1,219,766	Filed Feb. 20, 1909 Issued Mar. 20, 1917 For Bookkeeping Machine
H. Hollerith.....	1,295,167	For Mar. 26, 1913 Issued Feb. 25, 1919 For Registering & Recording Apparatus for Tabulating Systems
C. D. Lake.....	1,307,740	Filed Aug. 16, 1918 Issued June 24, 1919 For Tabulating Machine
J. R. Peirce.....	1,316,461	Filed Jan. 10, 1911 Issued Sept. 16, 1919 For Distributing Machine

SCHEDULE "A" TO ANSWER—Continued

Inventor	Patent No.	Filing & Issue dates and Title or Subject of Patent
C. D. Lake.....	1,372,965	Filed Nov. 11, 1918 Issued Mar. 29, 1921 For Electric Transfer Device (Renewed Aug. 24, 1920)
C. D. Lake.....	1,379,268 Reissue No. 16,304	Original filed Dec. 29, 1919 Issued May 24, 1921 Reissue filed Dec. 3, 1921 Reissue issued Mar. 30, 1926 For Printing Tabulator
C. D. Lake.....	1,501,004	Filed Mar. 6, 1922 Issued July 8, 1924 For Hammer Control for Tabulating Machines
[fol. 47]		
C. D. Lake.....	1,570,264	Filed Dec. 30, 1921 Issued Jan. 19, 1926 For Automatically Controlled Tabulating Machine
C. D. Lake.....	1,595,202	Filed Mar. 3, 1922 Issued Aug. 10, 1926 For Card Controlled Counting Machine
C. D. Lake.....	1,600,413	Original application Filed Apr. 30, 1921, divided and this application Filed Dec. 6, 1921 Issued Sept. 21, 1926 For Printing Tabulator
C. D. Lake.....	1,600,414	Original application Filed May 15, 1923, divided and this application Filed Dec. 13, 1924 Issued Sept. 21, 1926 For Resetting device for Counters, Accumulators and the Like.
F. M. Carroll.....	1,623,163	Filed Dec. 12, 1922 Issued Apr. 5, 1927 For Card Controlled Printing Machine

SCHEDULE "A" TO ANSWER—Continued

Inventor	Patent No.	Filing & Issue dates and Title or Subject of Patent
C. Campbell	1,658,022	Filed Apr. 10, 1925 Issued Jan. 31, 1928 For Record Card Controlled Statistical Machine
C. Campbell	1,667,881	Filed May 16, 1923 Issued May 1, 1928 For Record Card Operated Statistical Machine
[fol. 48]		
C. D. Lake	1,680,740	Filed Mar. 26, 1924 Issued Aug. 14, 1928 For Printing Tabulator
C. Campbell	1,681,152	Filed Jan. 22, 1926 Issued Aug. 14, 1928 For Total Taking Devices
J. W. Bryce et al	1,729,028	Continuation in part of application Serial No. 108,834, filed May 13, 1926. This application Filed May 21, 1928 Issued Sept. 24, 1929 For Transposing Device for Tabulating Machine
J. M. Cunningham	1,757,112	Filed Aug. 3, 1928 Issued May 6, 1930 For Commutator
C. D. Lake et al	1,757,123	Filed Feb. 5, 1925 Issued May 6, 1930 For Tabulating Machine
G. F. Daly et al	1,762,145	Filed Feb. 5, 1925 Issued June 10, 1930 For Tabulating Machine
J. W. Bryce	1,775,117	Filed Nov. 18, 1926 Issued Sept. 9, 1930 For Stationary Commutator Type Tabulator
C. D. Lake et al	1,775,132	Filed Sept. 10, 1925 Issued Sept. 9, 1930 For Tabulating Machine

SCHEDULE "A" TO ANSWER—Continued

Inventor	Patent No.	Filing & Issue dates and Title or Subject of Patent
G. F. Daly et al...	1,777,876	Filed May 12, 1928 Issued Oct. 7, 1930 For Printing Mechanism
[fol. 49]		
F. A. Storey.....	1,791,911	Filed Oct. 22, 1925 Issued Feb. 10, 1931 For Control Device for Tabulating Machines and the Like.
J. W. Bryce.....	1,791,953	Filed Sept. 28, 1927 Issued Feb. 10, 1931 For Translating Device for Accounting Machines
C. D. Lake.....	1,800,392	Filed July 31, 1925 Issued Apr. 14, 1931 For Control Device for Tabulating Machines
F. M. Carroll.....	1,803,959	Filed Oct. 21, 1925 Issued May 5, 1931 For Tabulating Machines
J. R. Peirce.....	1,808,432	Filed Dec. 24, 1923 Issued June 2, 1931 For Accounting Machine
J. W. Bryce.....	1,817,434	Filed Aug. 20, 1925 Issued Aug. 4, 1931 For Tabulating Machines
C. D. Lake.....	1,822,594	Filed May 15, 1923 Issued Sept. 8, 1931 For Tabulating Machines
C. A. Tripp.....	1,824,581	Filed June 9, 1917 Issued Sept. 22, 1931 For Punched Card Accounting Machine
J. R. Peirce.....	1,827,259	Filed Jan. 15, 1929 Issued Oct. 13, 1931 For Card Feeding Mechanism

[fol. 50] SCHEDULE "A" TO ANSWER—Continued

Inventor	Patent No.	Filing & Issue dates and Title or Subject of Patent
H. Hollerith	1,830,699	Filed Mar. 11, 1914 Issued Nov. 3, 1931 For Automatic Control for Tabulating Machines
T. J. Watson	1,834,561	Filed Apr. 4, 1925 Issued Dec. 1, 1931 For Accounting Machine & Punching Mechanism Controlled Thereby
F. L. Lee	1,839,398	Filed Aug. 4, 1928 Issued Jan. 5, 1932 For Brush Block Assembly
C. D. Lake	1,856,418	Filed July 18, 1925 To issue May 3, 1932 For Accounting Machine

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SCHEDULE "B" TO ANSWER

Inventor	Patent No.	Filing & Issue dates and Title or Subject of Patent
H. Hollerith	1,237,646	Filed Aug. 9, 1912 Issued Aug. 21, 1917 For Sorting Machine
J. W. Bryce	1,335,274	Filed May 15, 1919 Issued Mar. 30, 1920 For Tabulating Machine
C. D. Lake	1,372,964	Filed Aug. 24, 1920 Issued Mar. 29, 1921 For Attachment for Card Sorting Machines
R. E. Page	1,426,499	Filed June 11, 1921 Issued Aug. 22, 1922 For Single Column Selector for Card Sorting Machines (Renewed Jan. 16, 1922)

[fol. 51]

E. M. LaBoiteaux	1,516,772	Filed Mar. 1, 1924 Issued Nov. 25, 1924 For Tabulating Machine

SCHEDULE "B" TO ANSWER—Continued

Inventor	Patent No.	Filing & Issue dates and Title or Subject of Patent
E. A. Ford.....	1,741,985	Filed Nov. 7, 1924 Issued Dec. 31, 1929 For Sorting Machine
H. Kleckler.....	1,741,992	Filed Sept. 30, 1926 Issued Dec. 31, 1929 For Quick Setting Device for Brush Holders
E. A. Ford.....	1,830,756	Filed Jan. 25, 1927 Issued Nov. 10, 1931 For Counting Attachment for Accounting Machines
J. M. Cunningham.	1,835,382	Filed Feb. 5, 1929 Issued Dec. 8, 1931 For Stop Mechanism for Sorters

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SCHEDULE "C" TO ANSWER

Inventor	Patent No.	Filing & Issue dates and Title or Subject of Patent
C. W. Spicer.....	1,212,832	Filed July 15, 1911 Issued Jan. 16, 1917 For Record Element for Tabulating Systems
C. D. Lake.....	1,760,417	Filed Feb. 24, 1927 Issued May 27, 1930 For Detachable Record Card
C. D. Lake.....	1,772,492	Filed July 20, 1928 Issued Aug. 12, 1930 For Record Sheet for Tabulating Machines

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[fol. 52] SCHEDULE "D" TO ANSWER

Inventor	Patent No.	Filing & Issue dates and Title or Subject of Patent
O. E. Braitmayer..	1,277,039	Filed Oct. 12, 1917 Issued Aug. 27, 1918 For Paper Testing Machine

SCHEDULE "D" TO ANSWER—Continued

Inventor	Patent No.	Filing & Issue dates and Title or Subject of Patent
F. M. Carroll.....	1,563,014	Filed Apr. 14, 1922 Issued Nov. 24, 1925 For Tabulating Card Printer
F. M. Carroll.....	1,602,810	Filed Dec. 11, 1924 Issued Oct. 12, 1926 For Powdering Machine
F. M. Carroll.....	1,661,560	Filed Dec. 12, 1924 Issued Mar. 6, 1928 For Machine for Photographically Printing on Cylinders
F. M. Carroll.....	1,778,483	Filed June 15, 1925 Issued Oct. 14, 1930 For Machine for Operating Upon Web-like Material
O. E. Braitmayer..	1,812,620	Filed July 5, 1923 Issued June 30, 1931 For Punching Device

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[fol. 53] EXHIBIT "X" TO ANSWER

2M 12-15-31 M&E T-2531.

The Tabulating Machine Company

Division of International Business Machines Corporation,

270 Broadway, New York

Agreement for Tabulating Machine Service in the United States

Name: ——. Date: —, ——.
Street and No.: ——. No. —.
City and State: ——.

Service Offered:

The Tabulating Machine Company offers to furnish its Tabulating Machine Service, comprising the use of its machines as specified below; and Tabulating Cards for use in connection therewith and also the advice and counsel of its staff in applying the Tabulating System to your work, upon the following terms and conditions:

EXHIBIT "X" TO ANSWER—Continued

Style	Monthly Rental Each: Quantity	45-Column Equipment	Quantity	80-Column Equipment
Punches:				
Mechanical Key Punch	....	$5.00	....	$6.00
Electric Key Punch	....	6.50	....	7.50
Automatic Electric Key Punch	....	10.00	....	13.00
Electric Duplicating Key Punch	....	10.50	....	12.00
Automatic Electric Duplicating Key Punch	....	14.00	....	18.00
Automatic Electric Summary Card Punch	....	25.00	....	30.00
Automatic Gang Punch	....	25.00	....	35.00
Automatic Gang Punch (For Installation Numbering Devices)	....	30.00	....	40.00
Verifiers:				
Mechanical Key Punch Verifier	....	5.00	....	6.50
Motor Drive Verifier	....	10.00	....	13.00
[fol. 54] Interpreter:				
Automatic Interpreter	....	75.00	....	75.00
Sorters:				
Horizontal Sorter	....	35.00	....	40.00
Multiple Column Selection Device for Horiz. Sorter	....	10.00	....	10.00
Card Counting and Printing Sorter (1 bank)	....	85.00	....	85.00
Card Counting and Printing Sorter (2 bank)	....	120.00	....	120.00
Card Counting and Printing Sorter (3 bank)	....	150.00	....	150.00
Tabulators:				
3 Counter, 42 Column Non-Printing Tabulator	....	50.00	....	60.00
5 Counter, Non-Printing Tabulator	....	80.00	....	80.00
5 Counter, Automatic Control Tabulator	....	110.00	....	110.00
Printers:				
4 Bank, 3 Counter Total Printing & Listing Tabulator	....	100.00	....	105.00
4 Bank, 3 Counter Total Printing & Listing Tabulator, with magnetically actuated Major & Minor Control	....	110.00	....	115.00
5 Bank, 5 Counter Total Printing & Listing Tabulator	....	160.00	....	*
5 Bank, 5 Counter Total Printing & Listing Tabulator with magnetically actuated Major & Minor Control	....	170.00	....	175.00
7 Bank, 5 Counter Total Printing & Listing Tabulator	....	210.00	....	*
7 Bank, 5 Counter Total Printing & Listing Tabulator with magnetically actuated Major & Minor Control	....	220.00	....	225.00
Chain Store Billing Tabulator	....	*	....	200.00
Type IV Printer (7 Bank, 6 Counter, Direct Subtraction)	....	270.00	....	275.00
Class Selection Devices	....	5.00	....	5.00
Transfer Relays	....	5.00	....	5.00
Bill Feed Device	....	$30.00	....	$30.00
.....	....	.....	....	.....
.....	....	.....	....	.....

SCHEDULE "B" TO ANSWER—Continued

[fol. 55]

Reproducing Duplicators:

	Monthly Rental Each Quantity—Amount
Automatic Reproducing Duplicators:	
For reproducing 45 to 80 column cards.....	.... 35.00
" " 45 " 45 " "	.... 30.00
" " 80 " 80 " "	.... 35.00
" " 80 " 45 " "	.... 35.00

* Not Available.

Period of Contract:

This agreement for the aforementioned equipment shall remain in force for One Year from the date the machines are installed ready for your use, and may be terminated by you or this Company then, provided written notice is received three months prior, otherwise this agreement shall remain in full force and effect. Thereafter it may be terminated by you or this Company at the end of any calendar month provided three months prior written notice is received or unless terminated by us in accordance with the stipulations of this contract.

Rental Starts:

The rental is to commence in each case on the day following that on which each machine is installed ready for your use.

Additional or Replace Machines:

Machines, in addition to the above, or to replace any you may have in use, will be furnished you in accordance with the conditions of this contract at the rates prevailing at the time your order for same is received.

[fol. 56] License to Use:

In consideration of the rental paid for the machines, together with the purchase of cards from this Company and the prices paid therefor, this Company hereby gives you a non-assignable license to use the above machines at the place and for the work aforesaid, but such license and any contract based upon the acceptance of this proposition shall be terminated forthwith by any failure to pay when due the aforesaid rental of the machines, or in case any

cards that are not purchased from this Company are used in the operation of said machines. In the event of such termination you agree to pay in addition to the rental already accrued, rental for the machines at the full rate for the remainder of the contract period covered by this agreement.

Title to Machines:

All leased machines are to remain the exclusive property of this Company and may be removed by this Company at any time after the termination of said license and contract.

Restriction as to Use:

It is agreed that these machines will be used only by one shift of clerks, and this Company reserves the right to immediately charge, and you agree to pay, double the rental stipulated above for any machine used by more than one shift of clerks, for the period that the machine is so used; the minimum additional amount to be billed in any such case being one month's rental.

[fol. 57] No alterations in, or attachments to, these machines are to be made by you without the consent, in writing, of an officer of this Company.

Maintenance:

This Company will furnish the above machines complete, ready for attachment by you to such electric circuit as shall be specified by this Company and, except as hereinafter stated, will make at its own expense all necessary repairs to keep the machines in working order, but you agree to bear the expense of making all repairs and replacements necessitated by your negligence.

Electric Key Punches, Electric Duplicating Key Punches or Verifying Key Punches will be repaired either at our local office or at our factory without expense to you, excepting for the transportation charges both to and from such office or factory.

Traveling Expenses:

All traveling expenses of our representatives are to be paid by you, whether for installing, connecting, repairing

or replacing the machines, unless the machines are located at a place where we have a regular representative.

Supersedes All Previous Agreements:

The acceptance of this proposition cancels and supersedes all previous agreements between you and this Company for the use of all leased machines, and the use thereof hereafter is to be subject to this contract, without, however, changing the present monthly rates of payment for their use.

[fol. 58] Other Equipment and Cards:

Non-Electric Key Punching, Hand Gang Punching Machines and Cards for use in connection with Tabulating and Sorting Machines, will be sold you in accordance with the prices prevailing at the time orders for the same are received.

Transportation Charges:

You are to pay all transportation and drayage charges upon all cards and machines, and parts for repairs or replacements, both to and from our factories.

Packing and Packing Cases:

This Company will furnish the necessary crates or boxes for the return of all leased machines, or parts of same, without cost, except for transportation charges on same. If desired, this Company will furnish a representative to superintend the packing of such machines or parts, without charge, except for traveling expenses, the labor for packing the machines to be furnished by you.

You agree to pay the expense of repairing damages done to any machines returned to us that may have been caused by faulty packing, in cases where our representative does not supervise the packing.

[fol. 59] Terms:

Thirty days net from date of invoice. No cash discount for prepayment. All orders are subject to acceptance by this Company.

The Tabulating Machine Company, by —— ——.

The above proposition is accepted: Date: —— —, ——. Company: ——, by —— ——, Officer's Title: ——.

[fol. 60] Form #T-2509 5-1-31.

EXHIBIT "Y" TO ANSWER

The Tabulating Machine Company,

Division of International Business Machines Corporation,

270 Broadway, New York

No. 14639

Agreement for Tabulating Machine Service in the United States

1. This Lease, made and entered into this 1st day of July in the year One Thousand Nine Hundred and 31 by and between The Tabulating Machine Company, whose address is #270 Broadway, New York City, N. Y. for itself, its successors and assigns, hereinafter called the Lessor, and the United States of America, hereinafter called the Government:

Witnesseth: The parties hereto, for the considerations hereinafter mentioned, covenant and agree as follows:

2. The Lessor hereby agrees to give to the Government a non-assignable lease for any of the following described property as required at the monthly rental stated:

	Monthly Rental Each			
	Quantity	45-Column Equipment	Quantity	80-Column Equipment
Electric Key Punch #2781900	One	$7.50	....	$9.00
Automatic Electric Key Punch	....	12.00	....	15.50
Electric Duplicating Key Punch	....	12.50	....	14.00
Automatic Electric Duplicating Key Punch	....	16.50	....	21.00
[fol. 61]				
Verifying Key Punch #113489	One	6.00	....	7.50
Automatic Gang Punch	....	30.00	....	41.50
Automatic Interpreter	....	85.00	....	85.00
Vertical Sorter	....	30.00	....	***
Horizontal Sorter	....	40.00	....	45.00
Non-Print. Tabulator (3 counter)	....	60.00	....	***
Non-Print. Tabulator (5 counter)	....	95.00	....	95.00
Non-Print. Auto Control Tab. (5 counter)	....	130.00	....	130.00
Total Print. and Listing Tab. (5 counter)	....	190.00	....	***
Total Print. and Listing Tabulator (5-counter) with magnetically actuated major and minor control	....	200.00	....	205.00

	Monthly Rental Each			
	Quantity	45-Column Equipment	Quantity	80-Column Equipment
Total Print. and Listing Tab. (7 Bank)	....	250.00	....	***
Total Print. and Listing Tabulator (7 Bank) with magnetically actuated major and minor control	....	260.00	....	265.00
Card Counting & Printing Sorter (1 Ptg. Bk)	....	100.00	....	100.00
Card Counting & Printing Sorter (2 Ptg. Bks)	....	140.00	....	140.00
Card Counting & Printing Sorter (3 Ptg. Bks)	....	175.00	....	175.00

*** Not Available.

3. The Lessor agrees to furnish the required machines complete, ready for attachment by you to suitable sources of electrical energy (Direct Current) at U. S. Department of Justice, Supt. of Prisons, Wash, D. C., for use by the above, for fiscal year beginning July 1, 1931, and ending June 30, 1932.

4. This lease shall continue in force with respect to each machine installed in accordance with the provisions hereof, from the date machines are installed ready for use to the end of the Government fiscal year; however, the Government reserves the right, in the event the work for which [fol. 62] machines were installed, is completed or reduced in volume during the fiscal year, to discontinue any or all said equipment by thirty days' written notice to the Lessor.

5. The rental is to commence in each case on the day following that on which each machine is installed ready for use.

6. The Government shall pay the rental herein provided at the end of each calendar month, and rental of periods of less than a month shall be computed on the basis of thirty days for the month.

7. The Government agrees that these machines shall be used only by one shift of clerks; Provided, that in case more than one shift of clerks is necessary the rental shall be double for the period that any machines are so used.

8. The Lessor agrees to make, at its own expense, all necessary repairs and replacements and to keep the machines in working order, provided that if the Government

uses cards which are not manufactured by the Lessor the Lessor will be relieved from responsibility for correct and accurate tabulations by the machines while such cards are used. This exception, however, in nowise waives the obligation of the Lessor to repair and maintain said machines upon the terms herein set forth.

9. All leased machines are to remain the exclusive property of the Lessor and may be removed by the Lessor at any time after termination of said lease.

10. All travelling expenses of Lessor's representatives are to be paid by Government, whether for installing, con- [fol. 63] necting, repairing, or replacing machines, unless machines are located at a place where Lessor has a regular representative.

11. The Government agrees not to make any alteration in or attachments to the machines without the consent in writing of the Lessor, and to return the equipment to the Lessor in as good condition as when received, ordinary wear and tear excepted.

12. The Government agrees to pay all transportation and drayage charges upon the machines, equipment, and necessary cards and boxes from and to the factory, and to furnish such labor as may be necessary for packing the machines and equipment for their return. The Lessor agrees to furnish a representative to superintend such packing.

13. Non-electric key punching and hand gang punching machines, cards, skip bars, ink-ribbons, and supplies for use in connection with tabulating and sorting machines will be furnished Government in accordance with prices prevailing at the time orders for same are received.

14. The rentals specified in Paragraph numbered "2" hereof are based upon the exclusive use in any or all of said machines of cards manufactured and/or furnished by the Government Printing Office or by others than the herein named Lessor. If the Government uses with the machines any cards that have been manufactured by the Lessor, the rental above stipulated for each machine shall be reduced

for the period such cards are exclusively used. The rental rate will then be as follows:

[fol. 64]

	Monthly Rental Each			
	Quantity	45-Column Equipment	Quantity	80-Column Equipment
Electric Key Punch #2781900	One	$6.50	....	$7.50
Automatic Electric Key Punch	....	10.00	....	13.00
Electric Duplicating Key Punch	....	10.50	....	12.00
Automatic Electric Duplicating Key Punch	....	14.00	....	18.00
Verifying Key Punch #113489	One	5.00	....	6.50
Automatic Gang Punch	....	25.00	....	35.00
Automatic Interpreter	....	75.00	....	75.00
Vertical Sorter	....	25.00	....	***
Horizontal Sorter	....	35.00	....	40.00
Non-Print. Tabulator (3 counter)	....	50.00	....	***
Non-Print. Tabulator (5 counter)	....	80.00	....	80.00
Non-Print. Auto Control Tabulator (5 counter)	....	110.00	....	110.00
Total Print. and Listing Tab. (5 counter)	....	160.00	....	***
Total Print. and Listing Tabulator (5-counter) with magnetically actuated major and minor control	....	170.00	....	175.00
Total Print. and Listing Tabulator (7 Bank)	....	210.00	....	***
Total Print. and Listing Tabulator (7 Bank) with magnetically actuated major and minor control	....	220.00	....	225.00
Card Counting & Printing Sorter (1 Ptg. Bk)	....	85.00	....	85.00
Card Counting & Printing Sorter (2 Ptg. Bks)	....	120.00	....	120.00
Card Counting & Printing Sorter (3 Ptg. Bks)	....	150.00	....	150.00

*** Not Available.

15. The Lessor shall hold and save the Government, its officers, agents, servants, and employees harmless from liability of any nature or kind for, or on account of the use of any patented or unpatented invention, article or appliance furnished or used hereunder.

16. No member of, or delegate to, Congress, or Resident Commission, shall be admitted to any share or part of this lease or to any benefit to arise therefrom. Nothing, how- [fol. 65] ever, herein contained shall be construed to extend to any incorporated company, if the lease be for the general benefit of such corporation or company.

In Witness Whereof, the parties hereto have hereunto subscribed their names as of the date first above written.

The Tabulating Machine Company, by (Signed) C. A. Bruce, Treasurer.

The above proposition is accepted. Dated July 1, 1931. Department of Justice, by (Signed) J. W. Gardner.

[fol. 66] IN UNITED STATES DISTRICT COURT

[Title omitted]

STIPULATION FOR SEPARATE TRIAL AS AGAINST DEFENDANTS INTERNATIONAL BUSINESS MACHINES CORPORATION AND THE TABULATING MACHINE COMPANY

Referring to the stipulation this day filed between counsel for petitioner and counsel for Remington Rand Company, it is further stipulated and agreed by and between counsel for petitioner and counsel for defendant International Business Machines Corporation that the trial and determination of the issues in this cause as against the defendants Remington Rand Company and Remington Rand Business Service, Inc., may be severed and trial had separately as against defendants International Business Machines Corporation and The Tabulating Machine Company.

Dated October 28, 1935.

Geo. P. Alt, H. L. Godfrey, Special Assistants to the Atty. Gen'l. Davis, Auerbach & Cornell, Attorneys for Defendant. International Business Machine.

Nov. 12, 1935, approved: Jno. C. Knox, U. S. D. J.

[fol. 67] IN UNITED STATES DISTRICT COURT

[Title omitted]

STIPULATION BETWEEN REMINGTON RAND, INC., AND UNITED STATES AS TO ENTRY OF DECREE—Oct. 28, 1935

Whereas, the United States of America, on March 26th, 1932 filed its petition herein against the defendants above named, each of said defendants has answered and duly appeared by its respective solicitor, and the defendant Remington Rand Business Service, Inc., since the filing of its answer on May 14th, 1932, jointly with the defendant Remington Rand, Inc., has been dissolved, and the petitioner and the defendant Remington Rand, Inc., have agreed upon the entry of a consent decree herein without contest and with-

out the taking of any testimony, the terms and provisions of said decree and the entry thereof to be upon the conditions and stipulations hereinafter set forth; and it is intended by the petitioner and Remington Rand, Inc., that said consent decree or any modification thereof, as in this stipulation provided, shall be entered and become effective only if and when a final judgment or decree is entered, becomes and remains effective against the remaining de- [fol. 68] fendant, the International Business Machines Corporation,

It is hereby stipulated and agreed as follows:

1. If upon a final determination as to the defendant International Business Machines Corporation, the petition against it shall be dismissed, then the petition shall also be dismissed as against the defendant Remington Rand, Inc., to the same extent.

2. If and when a final judgment or decree is entered and becomes and remains effective against the defendant International Business Machines Corporation, the petitioner herein may upon 10 days notice to the defendant Remington Rand, Inc., cause to be entered the proposed decree annexed hereto against the defendant Remington Rand, Inc.; provided, however, that the defendant Remington Rand, Inc., shall have the right upon settlement of the proposed decree herein to have the annexed proposed decree or any provisions thereof modified to accord with the judgment or decree entered against the defendant International Business Machines Corporation or any provisions thereof; and provided that, if a decree should be entered against defendant International Business Machines Corporation granting relief under Section 3 of the Clayton Act but without prohibitions as to tying clauses with respect to tabulating cards having or designed for non-circular perforations or having other unique design arrangement, features or specifications either alone or in conjunction with tabulating machines, then the provisions of the annexed proposed decree providing relief with respect to Section 3 of the Clayton Act (that [fol. 69] is, the paragraph numbered "4" of the annexed proposed decree) shall be eliminated without prejudice in such event to the right of petitioner to institute further proceedings against the defendant Remington Rand, Inc., under Section 3 of the Clayton Act.

3. The execution of this stipulation and the consent by the defendant Remington Rand, Inc., to the entry of a decree in accordance with the terms hereof, shall be without prejudice to such defendant in any suits or proceedings between the defendants herein.

4. The petitioner reserves full rights to proceed separately herein against the defendants International Business Machines Corporation and the Tabulating Machine Company.

Dated October 28, 1935.

David L. Podell, Solicitor for Remington Rand, Inc. John Dickinson, Assistant Attorney General. Carl McFarland, George P. Alt, H. L. Godfrey, Hammond E. Chaffetz, Special Assistants to the Attorney General.

Approved: Jno. C. Knox, United States District Judge.

[fol. 70] IN THE DISTRICT COURT OF THE UNITED STATES FOR THE SOUTHERN DISTRICT OF NEW YORK

UNITED STATES OF AMERICA, Petitioner,

against

INTERNATIONAL BUSINESS MACHINES CORPORATION, REMINGTON RAND, INC., The Tabulating Machine Company and Remington Rand Business Service, Inc., Defendants

PROPOSED DECREE ANNEXED TO FOREGOING STIPULATION

The United States of America having filed its petition herein on March 26, 1932 and each of the defendants having duly appeared by its solicitor,

And the defendant Remington Rand Business Service, Inc., after filing its answer on May 14th, 1932 jointly with the defendant Remington Rand, Inc., having been dissolved,

And the defendant Remington Rand, Inc. having by stipulation consented to the making and entering of a decree upon ten days' notice after a final judgment or decree has been entered and made effective against the defendant International Business Machines Corporation without prejudice, however, to said defendant in any suits or proceedings

between the defendants herein and specifically reserving the lawful exercise of its rights arising out of, under and pursuant to the patent laws of the United States,

And a final judgment or decree having been duly entered and made effective against the defendant International Business Machines Corporation, and due notice thereof and of the intention to enter this decree having been given to the solicitor for the defendant Remington Rand, Inc. in ac- [fol. 71] cordance with the terms of said stipulation, and it appearing that this decree complies in all respects with the terms of said stipulation and that its entry conforms with the intention of the parties as expressed therein,

And it appearing that by reason of the consent of the said defendant Remington Rand, Inc. to this decree, and the acceptance of the same by the petitioner, it is unnecessary to proceed with the trial of the cause against said defendant or to take any testimony therein,

It is, in accordance with such consent, without taking any testimony or trial of the issues,

Ordered and decreed:

1. That the Court has jurisdiction of the subject matter and over the parties hereto; that the petition states a cause of action under the Act of Congress approved July 2, 1890, known as the Sherman Anti-Trust Act and the Act of Congress approved October 15, 1914, known as the Clayton Act; and that the defendants have been and are engaged in the business of manufacturing and distributing tabulating machines and tabulating cards in interstate commerce;

. That as used herein "tabulating machines" shall include tabulators and punches, punching machines, sorters and sorting machines or other machines used or to be used in connection with tabulating machines, tabulators or tabulating cards; and "tabulating cards" or "cards" shall include cards manufactured for use in connection with such machines;

[fol. 72] 3. That the defendant Remington Rand, Inc., its officers, directors, agents and employees and all persons acting for or on behalf of them, or any of them, be and they are hereby perpetually enjoined from making, entering into, carrying out or enforcing any agreement or understanding, express or implied, with competitors dealing in tabulating machines.

(a) prohibiting or preventing said defendant from selling tabulating machines or offering such machines for sale, or

(b) fixing the prices, rentals, terms or conditions for or under which said defendant may sell, lease, rent, or otherwise license the use of tabulating machines, or sell or dispose of tabulating cards, or

(c) requiring said defendant to sell, lease, rent or license the use of tabulating machines only on condition that the lessee or licensee shall purchase or otherwise obtain, directly or indirectly, tabulating cards from said defendant,

(d) requiring said defendant to incorporate as a condition of any contract of sale, lease, rental or license of tabulating machines that the purchaser, lessee, or licensee shall, because it obtains tabulating cards from any person other than said defendant, pay the cost of, or any additional [fol. 73] rental or charge for, repairs or maintenance, or

(e) restricting the freedom of said defendant to sell or encourage the sale or purchase of tabulating cards manufactured or sold by others, or

(f) restricting the freedom of said defendant to sell or dispose of its tabulating cards to users of tabulating machines other than those machines manufactured, sold, leased or licensed by itself;

4. That said defendant, its officers, agents, directors and employees and all persons acting on behalf of them or any of them, be and they are hereby perpetually enjoined from incorporating as conditions in any contract of sale, lease, rental or license of any tabulating machine,

(a) provisions that the purchaser, lessee or licensee use in connnection therewith tabulating cards manufactured or furnished by said defendant, or

(b) provisions for a decreased rental or charge, or no charge including service charges, on condition that the purchaser, lessee or licensee purchase tabulating cards from said defendant, or

(c) provisions for increased or additional rental or charge, including service charges, to be paid by the purchaser, lessee or licensee because of the use by such per-

sons of cards which are not manufactured or furnished by said defendant;

[fol. 74] 5. That said defendant shall, beginning within thirty days from the effective date hereof, give notice of modification or termination and shall modify or terminate any and all provisions in each of its outstanding leases, licenses or contracts relating to tabulating machines inconsistent with the provisions of this decree, at the earliest date permitted under the terms of each of such leases, licenses or contracts, or sooner with the assent of the lessee, licensee or other contracting party, in any event within eighteen months of the date hereof, except upon further order of the Court.

6. That jurisdiction is hereby expressly reserved for the purpose of enforcing or modifying this decree on application of any of the parties hereto.

Dated New York City, —— —, 1935.

—— ——, District Judge.

Entry of foregoing decree consented to —— ——, Solicitor for Remington Rand, Inc.

[fol. 75] In United States District Court

[Title omitted]

Stipulation of Facts

It is hereby stipulated and agreed by and between petitioner and defendants International Business Machines Corporation and The Tabulating Machine Company as follows:

1. The Agreement dated March 4, 1931, between The Tabulating Machine Company and Remington Rand, Inc. (Exhibit 1 attached to the petition) has been cancelled and is no longer in effect. The defendants, parties to this stipulation, agree that it will not be renewed and that they will not enter into any further agreement containing clauses the same as or similar to those objected to by petitioner; and that a consent decree in the form annexed hereto may be entered against them upon the final determination of the

remaining issues on the facts hereinafter stipulated and agreed, irrespective of the outcome as to such remaining issues.

2. The remaining issues in the case as between petitioner [fol. 76] and defendants, parties to this stipulation, shall be submitted to the Court for decision upon the pleadings (all affirmative allegations of the answer being deemed to be denied by petitioner), and upon the following agreed facts, subject to objections by either side to their relevancy or materiality, the right to interpose such objections being expressly reserved. If the Court should be of the opinion that a determination of the validity of any patents or applicability of any claims thereof to machines or cards is essential to a decision of the issues in this cause, the parties reserve the right either (a) to enter into a further stipulation with respect thereto, or (b) have any questions thus presented determined upon a trial of the facts:

(a) On or about June, 1934, defendant The Tabulating Machine Company was merged with the defendant International Business Machines Corporation, which acquired all the assets of The Tabulating Machine Company, including all leases of tabulating and related machines, and assumed all the liabilities of The Tabulating Machine Company, including those under its leases of tabulating and related machines. Said defendants will sometimes be referred to herein as "the International Company", or as "defendants"; the remaining defendants mentioned in the petition herein will be referred to as "the Remington Rand Company".

(b) Petitioner has for the past 30 years manufactured a very small number of tabulating machines with which tabulating cards are used, for use in the United States [fol. 77] Bureau of the Census. These machines are manufactured for petitioner's own use and not for sale. They differ from those manufactured by the defendants and by the Remington Rand Company, in that, while they are capable of performing certain of the functions performed by defendants' machines, they do not perform the variety of functions of which defendants' machines are capable.

(c) Tabulating machines made by the International Company are electrically operated; those made by Reming-

ton Rand Company are mechanically operated; and both are used to perform tabulating, recording, calculating and statistical work. Used in connection with such tabulating machines are sorting machines, punches, and tabulating cards. Tabulating cards are small cards, generally printed, and so designed that perforations in them, according to their various locations or relative positions, indicate numerical or other data. Tabulating cards when inserted in an electrically operated tabulating machine are moved to a point in the machine where they come in contact with a large number of small electrical brushes. Said brushes, through the perforations in the cards, establish electrical circuits, thus recording, tabulating, adding, computing, or otherwise registering the information denoted by the perforations in the cards. These machines pass the series or perforated cards over the brushes at a speed of approximately 150 cards per minute. Samples of said cards are attached hereto.

In the mechanically operated tabulating machines of the Remington Rand Company, instead of brushes small pins move into the holes in the tabulating cards, this movement, through linkage, causing the recording, tabulating, calculating, etc.

[fol. 78] Sorting machines of the International Company are electrically operated and are used to separate, sort, or classify tabulating cards, according to the perforations in them, in order to segregate or classify all or part of the information represented by such perforations. Electrical contact through a particular perforation actuates the sorting machine in accordance with the location of the particular perforation. In the mechanically operated sorting machines of the Remington Rand Company, the movement of a pin into the perforation of a card, through linkage, causes the operation of the machine. The defendants' sorter operates at a speed of approximately 300 to 400 cards a minute.

Punches of International Company, operated by hand, mechanically, or electrically, are used to make the perforations in the tabulating cards.

(d) All tabulating machines operated by holes in cards, and all punching machines and sorting machines used in connection therewith, which are now manufactured and available for commercial use in the United States, are manufactured and leased (except some hand punching machines

are sold) by the defendants or by the Remington Rand Company. They or their predecessors have made and now own substantially all of such tabulating machines which are being used in the United States by numerous business concerns, and by various departments, bureaus and administrative establishments of petitioner. Approximately 4303 tabulating machines, 4106 sorting machines and 8412 punches owned by the International Company are now in use in the United States. Other than petitioner, the pres- [fol. 79] ent users of such machines of the International Company total 3303. The International Company owns and leases approximately 85.7% of tabulating machines, 86.1% of such sorting machines and 81.6% of such punches now in use in the United States.

(e) Because of the increasing volume and complexity of the statistical data which the petitioner and many individuals, partnerships and corporations are required to assemble, classify and tabulate, tabulating machines and related sorting and punching machines of defendants and the Remington Rand Company have become and now are a practical business necessity or advantage for the petitioner and for many such individuals, partnerships and corporations. There are some machines manufactured by others than the defendants and Remington Rand Company which perform certain of the operations performed by defendants' tabulating machines, but there are no other machines (or combinations of other machines) available capable of performing without the intervention of additional manual operation the variety of functions performed by the tabulating machines of the defendants and the Remington Rand Company. Defendants' tabulating machines are commonly recognized to be superior in many ways to other machines which may be used for some of the same purposes.

(f) The following business machines manufactured and sold by others than the defendants in this case and the manner in which they perform may be described as follows:

The Comptometer consists of a machine arranged with a key board and the operator in entering amounts in this machine does so by the depression of the keys on the key board. This directly operates the adding wheels. When a [fol. 80] number of entries have been made the total of these

entries is shown on the adding wheels and copied off by the operator.

The National Cash Register, 2000 Series Register, comprises a key board and a number of individual accumulators or totalizers. Entries are made of amounts by depressing amount keys on the key board and classification of entries into any particular totalizer or totalizers is controlled by their keys. The machine also includes listing and recording mechanism for recording on sheets or rolls of paper each of the items entered into the machine. Operation is effected by an electric motor controlled from the key board. After a number of entries have been entered, totals may be obtained of the entries into any particular totalizer. The machine may be arranged for debit and credit entries, and bookkeeping balances thereon.

The Burroughs Adding Machine is made in several types, ranging from simple non-listing adding machines to the more complicated bookkeeping and statement making machines. In its more complicated form, the machine comprises a key board which is manipulated, upon which different classes of entries of amounts are made by an operator. The machine can add and subtract these entries, print the detail of the items, and obtain a series of printed totals. Such machines are widely used in various accounting practices.

The McBee Keysort is a hand operated device for rapidly sorting special cards into various classifications. These cards (which cannot be used in a tabulating machine) are provided with printed information placed upon them in any desired way and these cards are provided with a row of perforations around all of the edges, but spaced from the [fol. 81] edge. When a particular classification is to be designated, a card is placed in a punch which notches out the card from the edge to the hole. These cards are then placed in a filing device and by inserting by hand a long pin in the holes corresponding to the one desired classification to be selected and by raising the pin, these cards may be segregated or sorted from the other cards which have not been notched. This system may be utilized in connection with other listing adding machines such as Burroughs, in order to make calculations based upon the segregated data.

The Underwood Elliott Fischer machines are of various types comprising comparatively simple listing adding machines of the ten key type wherein entries are made by depression of keys, amounts listed and totals added up and total results printed on the tape. The more complicated forms of machines comprise a typewriting type of mechanism with which is associated calculating mechanism operated by the numeral keys of the typewriter. These machines are used for preparing statement forms of various sorts, recording lists or classified series of totals.

The Remington Rand machines comprise punching machines, sorting machines and tabulating machines. These machines in general correspond to those of the International Company, but in these machines action is mechanical, the power alone being supplied through electrical energy.

The Marchant Calculator is a calculating machine provided with a key board and an accumulating mechanism, wherein the accumulating mechanism is movable with re- [fol. 82] spect to the key board to facilitate multiplication and division. These machines are also capable of operation for a simple addition or subtraction. They are widely used in bookkeeping and statistical work or operations involving addition, subtraction, multiplication or division. In these machines the operation is wholly controlled by manually operable keys, but actual calculations are effected under power of an electric motor.

The Monroe Calculating Machine in its general results is the same as the Marchant Calculator mentioned above.

In none of these machines, other than those of the Remington Rand Company, may a card be inserted therein and information be derived therefrom mechanically or electrically; nor data recorded on cards, by the making of perforations therein, for use with tabulating machines.

None of these machines, other than those of the Remington Rand Company, is capable (as are defendants' machines) of simultaneously segregating or accumulating any desired combination of miscellaneous numerical or other recorded data, and of performing calculating or tabulating functions with such segregated or accumulated data, without the intervention of any further manual keyboard manipulation.

(g) The International Company does not sell (and has not, during the past thirty years, sold) but only leases tabulating machines, including sorting machines and punches used in connection therewith (with the exception of hand-operated punches, as distinguished from mechanically or electrically-operated punches, which said defend- [fol. 83] ant does sell). The lease agreements ordinarily used by said defendant provide that (1) the company reserves title to the machines covered by the agreement; (2) the machine user acquires only the right to possess and a license to use said machines; (3) the machine user shall use in connection with said machines only tabulating cards manufactured by the company; and (4) the machine user shall pay to the company a monthly rental. Said agreements provide that said defendant may forthwith resume possession of said machines if the user shall fail to observe the covenant to purchase tabulating cards for use in connection with said machines exclusively from said defendant. Typical forms of defendants' leasing contracts are attached.

(h) Agreements for the use by petitioner of tabulating machines of the International Company have not in all cases required petitioner to use only tabulating cards manufactured by said defendants, but have sometimes provided that if petitioner shall use in said machines tabulating cards not purchased from or manufactured by said defendant, the monthly rental shall be increased in sums provided for in the various agreements with petitioner. Such increased rental has been approximately 15% of the rental otherwise fixed in such agreements. The additional sums in the form of rentals heretofore collected by said defendant from petitioner because of the use of cards not manufactured or purchased from said defendant have amounted to many thousands of dollars. A typical form of defendants' government contract is attached.

(i) The International Company has been for approximately thirty years and now is engaged in the business of [fol. 84] manufacturing tabulating cards and in recent years has manufactured approximately 3,000,000,000 such cards annually. Said defendant manufacturers 81% of all such cards manufactured. Of the cards manufactured and sold by said defendant, 28% constitute 45-column cards, 72% constitute 80-column cards; and 1.4% of all cards con-

stitute 80-column cards which have been pre-punched, .3% of all cards constitute 45-column cards which have been pre-punched, and 4% constitute detachable record or stub cards. Except for such cards as are sold pre-punched, all cards sold by said defendant are punched by the users. An added charge is made for such pre-punching. The 45-column cards are designed for round holes, and the 80-column cards for rectangular holes. The 45-column cards and 90-column cards of the Remington Rand Company are designed for round holes.

(j) The International Company sells tabulating cards for use in connection with its machines. Purchasers of tabulating cards acquire title thereto and the cards do not become again the property of the International Company. Defendants and Remington Rand Company are the only concerns now engaged in manufacturing and selling tabulating cards in the regular course of business in the United States, but the Public Printer manufactures and sells tabulating cards to the various departments of the United States Government for use in the Government's machines and in machines leased from defendants and the Remington Rand Company.

(k) The International Company has earned a substantial profit on the manufacture and sale of tabulating cards, [fol. 85] the gross receipts derived from the sale of tabulating cards in the years 1926 to 1935, inclusive, being, respectively, as follows:

1926	$2,613,000	1931	$3,444,000
1927	$2,633,000	1932	$2,775,000
1928	$2,887,000	1933	$2,841,000
1929	$3,595,000	1934	$3,392,000
1930	$3,947,000	1935 (9 mos.)	$2,850,000

(l) It is possible for others than defendants to manufacture and sell satisfactory and usable tabulating cards. The manufacture of paper from which tabulating cards are made, is not the subject of Letters Patent or secret processes. Defendants do not restrict their paper stock suppliers in their relations with others.

(m) The United States patents listed in Schedules A, B, C and D, annexed to the answer of the International Company, were issued to and are owned by said defendant.

The International Company asserts that the patents listed in Schedules A and B describe and cover its tabulating machines and sorting machines, respectively. The following of these patents relating to tabulating machines contain claims as follows:

Hollerith Patent No. 1,295,167: Claim 3, which is typical reads:

3. In apparatus of the character described, in combination, recording mechanism having normally active recording members, an electric circuit, electro-magnets in said circuit, a record-card having index-point positions and moving in synchronism with said recording members, means actuated by the index-points for controlling said magnets, and means actuated by said magnets for arresting said members.

(In the specification and drawings, punch perforations in the cards are described and shown as identifying the "index-points" mentioned in the claims.)

[fol. 86] Hollerith Patent No. 1,830,699: Claim 2, which is typical reads:

2. In an apparatus of the character described, the combination with record-cards having groups of index-points, of a register controlled by one group of index-points, and means concurrently controlled by another group of index-points of a plurality of record-cards for normally maintaining the operation of such register and for automatically discontinuing such operation when such latter index-points do not correspond.

Lake Patent No. 1,570,264: Claim 2, which is typical, reads:

2. In an apparatus of the class described, the combination of record cards having index-points, of a record-actuated register, index-point controlled means called into action when record groups change for stopping the registering operations, means for resetting the register, and means for automatically initiating restarting of the registering operation upon a new record card group after the register has been reset.

(Index-points are shown and described as punch perforations in the cards.)

Lake Reissue Patent No. 16,304 (of original No. 1,379,268). Claim 33, which is typical, reads:

33. In a perforated card control mechanism, in combination, electrically controlled tabulating means for accumulating items from record cards means for taking printed records of subtotals of said items, and means for taking a printed grand total of all of said subtotals.

Lake Patent No. 1,600,413: Claim 4, which is typical, reads:

4. In a card-controlled machine of the class described, in combination, a tabulating machine for accumulating items from record cards, means called into action upon the arrival of a record card which is unlike the preceding record card for interrupting the tabulating operation, and a printing device controlled from the record card conjointly with the aforesaid means for printing the first group number and the successive item amounts of a group number and the successive item amounts of a group of cards, said printing device having provisions for printing the total of the items tabulated and for printing in correspondence therewith the [fol 56] group number of the items making up said total, said printing device having provisions for suppressing the printing of group numbers between the first card of a group and the total of said group.

The following patent listed in Schedule B, relating to sorters, contains claims as follows:

Ford Patent No. 1,741,985: Claim 45, which is typical, reads:

45. A card sorting machine comprising card analyzing means, a plurality of blades forming distributing passages between them, means controlled by said analyzing means and including an analyzed card cooperating with said blades to constitute a passage opening element to select a distributing passage for itself according its analysis by the analyzing means.

The following patent listed in Schedule C, relates to cards: (In the cards which are made and sold by defendant for use by its customers in its "80-column" machines, the perforations are long and narrow as distinguished from round holes, whereby a much increased number of holes may be punched in a card of a given size, thus adapting it for use on a machine of 80 columns of much increased capacity.)

Lake Patent No. 1,772,492: Claim 1, which is typical reads:

1. A tabulating card having oblong control apertures arranged in vertical columns and horizontal lines with the greater dimension in the vertical direction whereby the card is stronger and contains more perforations than a similar card having similarly arranged and spaced circular perforations of a diameter equal to said vertical dimension.

The following patents, contained in Schedule D, relate to the manufacture of cards:

Braitmayer Patent No. 1,277,039, (expired August 27, [fol. 88] 1935) relates to a machine for testing card material from which cards are cut, the machine being so arranged that if an imperfection in the paper is encountered mechanism is brought into operation for cutting, destroying or damaging a section of the paper, so that it may be removed from the supply.

Carroll Patents Nos. 1,602,810 and 1,661,560 relate to machines for making printing cylinders which may be used upon machines for printing and cutting paper strips into cards.

Carroll Patents Nos. 1,563,014 and 1,778,483 relate to machines for printing and cutting strips of card material into accurately sized and printed cards.

Said defendants assert that the alleged improvements claimed by the foregoing patents listed in Schedule D are employed by them in the manufacture of their tabulating cards. Machines described in the last named Carroll patents have an output of 400 accurate cards per minute. Copies of any of the patents herein referred to and of such other patents as the petitioner may file at the hearing (copies thereof being first furnished to defendants) may be filed and be incorporated in the record on appeal.

(n) Tabulating cards for use in defendants' machines must be of almost precisely accurate dimensions, and must be free of carbon spots, or slime spots, or irregularities of surface. A carbon spot in a card may cause an erroneous and unintended electrical contact, resulting in an erroneous sorting. The parts of the sorting machine are accurately coordinated to the card sizes, subject only to minute tolerances. If the card is not accurate as to size or thickness within its tolerance, or if the perforation is not accurately punched within the dimensions of the card, or if the card contains carbon spots, or slime spots, or irregularities of [fol. 89] surface, it may become erroneously sorted and may crumple, and clog the sorting machines.

Likewise, the parts of defendants' tabulating machines are accurately coordinated to the card size, subject only to minute tolerances. Each card is pushed down (from large numbers of other cards behind it and from the card immediately behind it and in contact with it) by a metal plate having at the top thereof a ridge of five one-thousandth (5/1000) of an inch projection. Each plate operates at a speed of 150 movements per minute. If any card is too thin, the result of the operation of this particular part of the machine may be that two cards will be drawn down and may clog at the next passage. Likewise, if any card is too thick or uneven in thickness, or with an irregular edge, it may crumple and clog the work. All machines may be adjusted for cards of different thickness within minute tolerances; but if operated upon cards promiscuously arrayed, some of greater and some of lesser thickness, the machines will not feed the cards or otherwise function.

The card in order to be properly located in the position it takes in relation to the electrical brushes in such tabulating machine and sorters must be accurately cut to dimension; if too large it will clog; if too small or not cut at the proper angle the perforations will not be brought in contact with the proper electrical brushes; if the card contains carbon spots or metallic particles, unintended electrical contact may take place through the carbon spots or particles and register erroneous results. Improper surfacing of card, curl in the card, or slime spots in the card, may [fol. 90] clog the operation of the machine or throw off the accuracy of the result.

(o) When the card is passed across the electrical contacts its non-conducting character is necessary to prevent electrical contact through all save the perforations, and the operation of the tabulating machine is by virtue of the elimination of all electrical contact save the intended contacts through the perforations. Such electrical contacts through the perforations operate and control the mechanism in the statistical recording.

(p) The card is not immediately destroyed in the sorting and other operations, but may be used over and over again, sorted to different perforations upon it, as required, and used with the machines, operating now through this and now through that perforation or series of perforations until worn out and may then be duplicated, through reproducing machines, for further use. Toughness and smoothness of surface, durability and stiffness are essential in a card for prolonged use.

(q) The machines require for their operation a card especially manufactured. The cards used in tabulating machines have no other use, value or function, save for use in those machines.

(r) There are no cards on the general market manufactured for other purposes which are appropriate for use in defendants' machines.

(s) The International Company sells time recording cards for use upon time recorders made by it and used generally by employers for recording the work hours of em- [fol. 91] ployees; also carbon paper, ink, ribbon and record sheets, and other such supplies for both time recorders and tabulating machines, but makes no restriction or limitation upon its lessees or customers as to preventing them from obtaining such supplies upon a general market.

(t) These defendants manufacture their own cards, exercise particular care in the selection of paper stock, test all paper stock with a speck detector (photographs attached and made a part hereof), which runs all the paper over fine electrical brushes, which, on any contact through the paper, operates cutting or marking machinery to ascertain and eliminate the defective part of the paper. The paper after being tested is then cut on machinery especially devised for the purpose and printed on machinery especially devised and adapted to the purpose.

The arrangement of the lines, figures and numbers on the card varies with the necessities of different customers or classes of customers so that card design and layout is a service ordinarily furnished by defendants to their customers in relation to the making of the card so that the perforations may be made in the appropriate locations for the segregation of the accounting and statistical data. This card design or layout (a service furnished by these defendants which is included in the price of the card) is made upon a large sheet photographically reduced to proper proportions and then photo-engraved upon a printing cylinder.

(u) In order to furnish such card design and layout service, the defendant has gone to great expense in the maintenance of a school for the education of its salesmen.

(v) During the last thirty years, the intricacy of defend- [fol. 92] ants' machines, the speed at which they are run, and the functions they perform for lessees have much increased.

The defendants' machines have always used cards of various sizes made of paper; and these cards have always been provided with perforations, have always permitted the closing of electrical circuits through the holes therein so as to cause tabulating, sorting, etc., and have always operated in timed sequence with the machines.

If a hole is either ahead of or behind its proper position (due to inaccuracy in card beyond co-ordinated tolerances of machine), the circuit will be established through the card hole at an instant which is out of time with the circuit breakers of the machine and out of time with other parts which the circuit is to control. This may produce an error in the calculation or operation performed by the machines.

(w) The International Company may ask leave of the Court to demonstrate, without testimony, the operation of its machines in relation to the cards, and of the machines referred to in paragraph (f).

(x) Satisfactory paper for the manufacture of tabulating cards is available other than from the source of supply from which defendants obtain the paper used in the manufacture of their tabulating cards. The United States Government Printing Office manufactures tabulating cards which have been found to be satisfactory employing its own

methods and machines and such cards are now being used in large quantities daily in the Government's machines and in machines leased by the Government from the defendants and the Remington Rand Company. Cards manufactured [fol. 93] by the Remington Rand Company are mechanically satisfactory for use in the 45-column machines of the International Company, but are not now electrically tested.

(y) On August 15, 1927, George H. Carter, then Public Printer for the United States, made application to the Federal Trade Commission to institute a proceeding against the International Company in respect of the clauses of its leases limiting the lessees to tabulating cards of its manufacture. After a preliminary investigation and an ex parte hearing, at which only the International Business Machines Corporation, The Tabulating Machine Company and the Remington Rand Company were heard, the Commission declined to issue any complaint.

Exhibits to be furnished 28 Oct., 1935.

Geo. P. Alt, H. L. Godfrey, Hammond E. Chaffetz, Special Assistants to the Attorney General.
Davies, Auerbach & Cornell, Attorneys for Defendant.

(Here follow 3 sample tabulating cards, Exhibits (a), (b) and (c))

Sample Tabulating Cards, Exhibits (a), (b) and (c) to Stipulation of Facts

(a) PUNCHED TABULATING CARD, 80-COLUMN

(b) Unpunched Tabulating Card (Unprinted)

(c) Unpunched 45-Column Tabulating Card

✓ Form of agreement re tabulating machine service in the United States, Exhibit D to Stipulation of Facts

INTERNATIONAL BUSINESS MACHINES CORPORATION

TABULATING MACHINE DIVISION

270 Broadway, New York

Agreement for

TABULATING MACHINE SERVICE

In the United States

Name _____ No.

Street and No. _____ Date

City and State _____

Service Offered The International Business Machines Corporation offers to furnish its Tabulating Machine Service, comprising the use of its machines as specified below; and Tabulating Cards for use in connection therewith and also the advice and counsel of its staff in applying the Tabulating System to your work, upon the following terms and conditions:

	Style	MONTHLY RENTAL EACH			
		Quantity	45-Column Equipment	Quantity	80-Column Equipment
Punches	Mechanical Key Punch		$5.00		$6.00
	Electric Key Punch		6.50		7.50
	Motor Drive Key Punch		10.00		13.00
	Duplicating Key Punch		10.50		12.00
	Motor Drive Duplicating Key Punch		14.00		18.00
	Alphabetic Duplicator		*		25.00
	Automatic Reproducing Duplicators (See 2d page)				
	Automatic Summary Punch		25.00		30.00
	Motor Drive Gang Punch		25.00		35.00
	Motor Drive Gang Punch (For Installation of Numbering Devices)		30.00		40.00
Multiplier	Multiplying Punch		125.00		130.00
	Cross Footing Multiplying Punch		135.00		140.00
Verifiers	Mechanical Verifier		5.00		6.50
	Motor Drive Verifier		10.00		13.00
Interpreter	Automatic Interpreter		50.00		50.00
	Automatic Check Writing Interpreter		50.00		50.00
Sorters	Horizontal Sorter		35.00		40.00
	Electric Non-Printing Counting Sorter		45.00		50.00
	Electric Printing Counting Sorter (1 bank)		85.00		85.00
	Electric Printing Counting Sorter (2 bank)		120.00		120.00
	Electric Printing Counting Sorter (3 bank)		150.00		150.00
Tabulators	Electric Tabulator (Three Counter, 42 Column)		50.00		60.00
	Electric Tabulator (Five Counter)		80.00		80.00
	Automatic Control Tabulator		110.00		110.00
Printers	Accounting Machine (4 Bank, 3 Counter)		100.00		105.00
	Accounting Machine (4 Bank 3 Counter), with magnetically actuated Major & Minor Control		110.00		115.00
	Accounting Machine (5 Bank, 5 Counter)		160.00		*
	Accounting Machine (5 Bank, 5 Counter), with magnetically actuated Major & Minor Control		170.00		175.00
	Accounting Machine (7 Bank, 5 Counter)		185.00		*
	Accounting Machine (7 Bank, 5 Counter), with magnetically actuated Major & Minor Control		195.00		200.00
	Accounting Machine (Invoicing Tabulator)		*		190.00
	Accounting Machine (Alphabetic)		*		250.00
	Accounting Machine (Alphabetic Direct Subtraction)		*		275.00
	Accounting Machine (Direct Subtraction)		270.00		275.00

* Not Available

95

T-3569—1500—7-23-35—M&E

Reproducing Duplicators

Automatic Reproducing Punches:	MONTHLY RENTAL EACH QUANTITY—AMOUNT
For reproducing 45 to 80 column cards _____	_____ $35.00
" " 45 " 45 " " _____	_____ 30.00
" " 80 " 80 " " _____	_____ 35.00
" " 80 " 45 " " _____	_____ 35.00

Special Devices

Style	Quantity	MONTHLY RENTAL EACH 45-Column Equipment	Quantity	80-Column Equipment
Class Selection Devices _____	_____	$5.00	_____	$5.00
Transfer Relays _____	_____	5.00	_____	5.00
Bill Feed Device _____	_____	20.00	_____	20.00
Intermediate Control Device _____	_____	5.00	_____	5.00
Preset Selection Device _____	_____	10.00	_____	10.00
Collating Device _____	_____	10.00	_____	10.00
Group Sorting Device _____	_____	10.00	_____	10.00
Multiple Column Selection Device for Horizontal Sorter _____	_____	10.00	_____	10.00

Taxes

Taxes now in effect, or if and when levied on the rentals or sales covered in this agreement, are to be added to the scheduled prices.

Period of Contract

This agreement for the aforementioned equipment shall remain in force for One Year from the date the machines are installed ready for your use, and may be terminated by you or this Corporation then, provided written notice is received three months prior, otherwise this agreement shall remain in full force and effect. Thereafter it may be terminated by you or this Corporation at the end of any calendar month provided three months prior written notice is received or unless terminated by us in accordance with the stipulations of this contract.

Rental Starts

The rental is to commence in each case on the day following that on which each machine is installed ready for your use.

Additional or Replace Machines

Machines, in addition to the above, or to replace any you may have in use, will be furnished you in accordance with the conditions of this contract at the rates prevailing at the time your order for same is received.

License to Use

In consideration of the rental paid for the machines, together with the purchase of cards from this Corporation and the prices paid therefor, this Corporation hereby gives you a non-assignable license to use the above machines at the place and for the work aforesaid, but such license and any contract based upon the acceptance of this proposition shall be terminated forthwith by any failure to pay when due the aforesaid rental of the machines, or in case any cards that are not purchased from this Corporation are used in the operation of said machines. In the event of such termination you agree to pay in addition to the rental already accrued, rental for the machines at the full rate for the remainder of the contract period covered by this agreement.

Title to Machines

All leased machines are to remain the exclusive property of this Corporation and may be removed by this Corporation at any time after the termination of said license and contract.

Restriction as to Use

It is agreed that these machines will be used only by one shift of clerks, and this Corporation reserves the right to immediately charge, and you agree to pay, double the rental stipulated above for any machine used by more than one shift of clerks, for the period that the machine is so used; the minimum additional amount to be billed in any such case being one month's rental.

No alterations in, or attachments to, these machines are to be made by you without the consent, in writing, of an officer of this Corporation.

Maintenance This Corporation will furnish the above machines complete, ready for attachment by you to such electric circuit as shall be specified by this Corporation and, except as hereinafter stated, will make at its own expense all necessary repairs to keep the machines in working order, but you agree to bear the expense of making all repairs and replacements necessitated by your negligence.

Electric Key Punches, Electric Duplicating Key Punches or Verifiers will be repaired either at our local office or at our factory without expense to you, excepting for the transportation charges both to and from such office or factory.

Traveling Expenses All traveling expenses of our representatives are to be paid by you, whether for installing, connecting, repairing or replacing the machines, unless the machines are located at a place where we have a regular representative.

All Previous Agreements The acceptance of this proposition merges all previous agreements between you and this Corporation for the use of all leased machines, and the use thereof hereafter is to be subject to this contract, without, however, changing the present monthly rates of payment for their use.

Other Equipment and Cards Non-Electric Key Punching, Hand Gang Punching Machines and Cards for use in connection with Tabulating and Sorting Machines, will be sold you in accordance with the prices prevailing at the time orders for the same are received.

Transportation Charges You are to pay all transportation and drayage charges upon all cards and machines, and parts for repairs or replacements, both to and from our factories.

Packing and Packing Cases This Corporation will furnish the necessary crates or boxes for the return of all leased machines, or parts of same, without cost, except for transportation charges on same. If desired, this Corporation will furnish a representative to superintend the packing of such machines or parts, without charge, except for traveling expenses, the labor for packing the machines to be furnished by you.

You agree to pay the expense of repairing damages done to any machines returned to us that may have been caused by faulty packing, in cases where our representative does not supervise the packing.

Terms Thirty days net from date of invoice. No cash discount for prepayment. All orders are subject to acceptance by this Corporation.

INTERNATIONAL BUSINESS MACHINES CORPORATION,
(TABULATING MACHINE DIVISION),

By _____
Authorized Signature

The above proposition is accepted:

Dated _____

_____
Company

By _____

_____
Officer's Title

T-514-A

EXHIBIT "E" to stipulation of facts

INTERNATIONAL BUSINESS MACHINES CORPORATION

THE TABULATING MACHINE COMPANY DIVISION
50 BROAD STREET
NEW YORK

Contract for
TABULATING MACHINE SERVICE
In the United States

Date August 2, 1927

No. 10331

U. S. Department of Agriculture
Bureau of Agricultural Economics
Washington, D. C.

Service Offered

The Tabulating Machine Company offers to furnish its Tabulating Machine Service, comprising the use of its Electric Total Printing and Listing Tabulating Machine; the Non Printing Tabulating Machine, equipped with Automatic Control; Standard Tabulating Machine; Automatic Electrical Horizontal or Vertical Sorting Machines, together with Key Punching, Key Verifying and Gang Punching Machines; all as specified below; and Tabulating Cards for use in connection therewith and also the advice and counsel of its staff in applying the tabulating system to your work of

Statistics at Washington, D. C.

upon the following terms and conditions:

Rental of Printing Tabulators

Total Printing and Listing Tabulating Machines,

Quantity	Printing Banks	Columns	Monthly Rental
_____	5	42	$150.00 each
Two #1551477--155163-1	5	45	160.00 "
_____	7	42	200.00 "
One ~~#1760[illegible]~~ #1700422	7	45	210.00 "

Total Printing and Listing Tabulating Machines:
Equipped with Major and Minor Control, Magnetically Actuated:

Quantity	Printing Banks	Columns	Monthly Rental
_____	5	42	$160.00 each
_____	5	45	170.00 "
_____	7	42	210.00 "
_____	7	45	220.00 "

Rental of Non-Printing Tabulator with Automatic Control

Non-Printing Tabulating Machines, Equipped with Automatic Control

Quantity	Counters	Columns	Monthly Rental
_____	5	42	$100.00 each
_____	5	45	110.00 "

Rental of Standard Tabulators

Standard Tabulating Machines: (Non-Listing)

Quantity	Counters	Columns	Monthly Rental
_____	3	42	$50.00 each
_____	5	42	70.00 "

Rental of Sorting Machines

Sorting Machines:

Quantity	Style	Monthly Rental
_____	Vertical	$25.00 each
Three #50373 #50368 #51371	Horizontal	35.00 "

Rental of Electric Key Punch and Electric Duplicating Key Punch

Electric Key Punches:

Quantity	Style	Monthly Rental
Three #23404 #23405 23406	Electric Key Punch	$6.50 each
Six #30535-30537 30579 #30956-30968-30952	Electric Dup-Key Punch	10.50 "

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Period of Contract

This agreement for the aforementioned equipment shall remain in force to the end of the Government fiscal year from the date that the machines are installed ready for your use, unless terminated by us in accordance with the stipulations of this contract, with the exception that the use of the Standard Tabulating and Vertical Sorting Machines may be terminated by you at the close of any calendar month.

Rental Starts

The rental is to commence in each case on the day following that on which each machine is installed ready for your use.

Additional or Replace Machines

Tabulating Machines, Sorting Machines or Electric Key or Electric Duplicating Key Punches, in addition to the above, or to replace any you may have in use, will be furnished you in accordance with the conditions of this contract at the rates herinbefore stated.

License to use

In consideration of the rental paid for the machines and conditioned upon the purchase of Tabulating Cards from this Company, as hereinafter specified, and the prices paid therefor, this Company hereby gives you a non-assignable license to use the above named machines at the place and for the work aforesaid, but such license and any contract based upon the acceptance of this proposition may be terminated forthwith by failure to pay when due the aforesaid rental of the machines, except as hereinafter stated. In the event of such termination you agree to pay in addition to the rental already accrued, rental for the machines at the full rate for the remainder of the first year, or contract period covered by this agreement.

The rentals hereinbefore stipulated are based upon the exclusive use, in any or all said machines, of cards purchased from the Tabulating Machine Company. In the event the Government requires the right to use in any of the said machines cards printed at the Government Printing Office, then you agree to pay a fifteen percent increase in the rental of all leased machines covered by this agreement, such increased rental to commence on the day upon which you first use or punch any government-made cards. In the event you resume the exclusive use of cards purchased from this company, the fifteen percent increase in rental shall be waived, such waiver commencing with the day upon which you start punching exclusively cards purchased from this company, and continuing so long as cards purchased from us exclusively are so used.

Title to Machines

All Tabulating Machines, Sorting Machines, Electric Key and Electric Duplicating Key Punches are to remain the exclusive property of this Company and may be removed by this Company at any time after the termination of said license and contract.

Restriction as to Use

It is agreed that these machines will be used only by one shift of clerks, and this Company reserves the right to immediately charge, and you agree to pay, double the rental stipulated above for any machine used by more than one shift of clerks, for the period that said machines are so used.

No alterations in, or attachments to, these machines are to be made by you without the consent, in writing, of an officer of this Company.

100

Maintenance

This Company will furnish the above machines complete, ready for attachment by you to a suitable source of electrical energy (direct current) and, except as hereinafter stated, will make at its own expense and all necessary repairs and replacements to keep the machines in working order, but you agree to bear the expense of making all repairs and replacements necessitated by your negligence.

Electric Key or Electric Duplicating Key Punches will be repaired either at our local office or at our factory without expense to you excepting for the transportation charges both to and from such office or factory.

Traveling Expenses

All traveling expenses of our representatives are to be paid by you, whether for installing, connecting, repairing or replacing the machines, unless the machines are located at a place where we have a regular representative.

Other Equipment and Cards

Non-Electric Key Punching, Key Verifying and Gang Punching Machines, and Cards for use in connection with Tabulating and Sorting Machines, will be sold you in accordance with the prices prevailing at the time orders for the same are received.

Transportation Charges

You are to pay all transportation and drayage charges upon all cards and machines, and parts for repairs or replacements, both to and from our factories.

Packing and Packing Cases

This Company will furnish the necessary crates or boxes for the return of Tabulating or Sorting Machines, or parts of same, and Electric Key and Electric Duplicating Key Punches, without cost, except for transportation charges on same. If desired, this Company will furnish a representative to superintend the packing of such machines or parts, without charge, except for traveling expenses, the labor for packing the machines to be furnished by you.

You agree to pay the expense of repairing damages done to any machines returned to us that may have been caused by faulty packing, in cases where our representative does not supervise the packing.

Terms

Thirty days net from date of invoice. No cash discount for prepayment. All orders are subject to acceptance by this Company.

THE TABULATING MACHINE COMPANY

By A. P. Brice

The above proposition is accepted:

Dated _____

_____

Company

UNITED STATES OF AMERICA

By R. W. Dunlap

Acting Secretary of Agriculture

Officer's Title

101

[fol. 102] EXHIBIT (F) TO STIPULATION OF FACTS—FORM OF CONSENT PROVISIONS TO BE INSERTED IN FINAL DECREE

IN THE DISTRICT COURT OF THE UNITED STATES FOR THE SOUTHERN DISTRICT OF NEW YORK

UNITED STATES OF AMERICA, Petitioner,

v.

INTERNATIONAL BUSINESS MACHINES CORPORATION, REMINGTON RAND, INC., The Tabulating Machine Company and Remington Rand Business Service, Inc., Defendants

Decree

[Appropriate recitals to be incorporated, and apart from such additional provisions, if any, as may be added after determination of the issues reserved for trial, the following provisions shall be included:]

That the defendant International Business Machines Corporation, its officers, directors, agents and employees and all persons acting for or on behalf of them, or any of them, be and they are hereby perpetually enjoined from making, entering into, carrying out or enforcing any agreement or understanding, express or implied, with competitors dealing in tabulating machines

(a) Prohibiting or preventing said defendant from selling tabulating machines or offering such machines for sale, or

(b) fixing the prices, rentals, terms or conditions for or under which said defendant may sell, lease, rent, or otherwise license the use of tabulating machines, or sell or dispose of tabulating cards, or

(c) requiring said defendant to sell, lease, rent or license [fol. 103] the use of tabulating machines only on condition that the lessee or licensee shall purchase or otherwise obtain, directly or indirectly, tabulating cards from said defendant,

(d) requiring said defendant to incorporate as a condition of any contract of sale, lease, rental or license of tabu-

lating machines that the purchaser, lessee, or licensee shall, because it obtains tabulating cards from any person other than said defendant, pay the cost of, or any additional rental or charge for, repairs or maintenance, or

(e) restricting the freedom of said defendant to sell or encourage the sale or purchase of tabulating cards manufactured or sold by others, or

(f) restricting the freedom of said defendant to sell or dispose of its tabulating cards to users of tabulating machines other than those machines manufactured, sold, leased or licensed by itself.

(Here follows 1 photo, folio 104)

Report showing classified rentals, Exhibit (g) to Stipulation of Facts

International Business Machines Corp.

Tabulating Machine Division

Report showing the Total Rentals classified according to Tabulators, Sorters and Punches

Year	TABULATORS.	SORTERS	PUNCHES	TOTAL
1926	4,174,577.	803,080.	223,263.	5,200,920.
1927	4,858,078.	1,004,727.	347,461.	6,210,216
1928	5,517,399.	1,133,793.	494,086.	7,144,778
1929	6,633,134.	1,360,316.	743,727	8,737,177.
1930	7,779,295.	1,602,153.	1,067,531	10,448,979.
1931	8,361,540.	1,731,288.	1,428,803.	11,521,651
1932	8,033,700.	1,652,474.	1,582,115	11,268,289.
1933	7,223,607.	1,503,132.	1,774,061	10,500,800.
1934	8,080,333	1,711,037.	2,380,903.	12,172,273.
First Nine months 1935	6,774,355	1,376,760.	2,271,992	10,423,107.

J. L. Evans
11/7/35

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PGA

[fol. 105] EXHIBIT (H) TO STIPULATION OF FACTS

Certified Copies of Patents Referred to in Stipulation of Facts, Filed by United States of America

12 patents referred to in stipulation, numbers:

1,295,167	1,772,492
1,830,699	1,277,039
1,570,264	1,602.810
16,304 (reissue.)	1,661,560
1,600,413	1,563,014
1,741,985	1,778,483

5 patents referred to in patents referred to in stipulation, numbers:

677,214	945,236
685,608	1,087,061
12,523 (reissue.)	

Also 3 other patents, numbers:

367,646 (German)
13,751 (British, 1902)
518,885.

H. HOLLERITH.

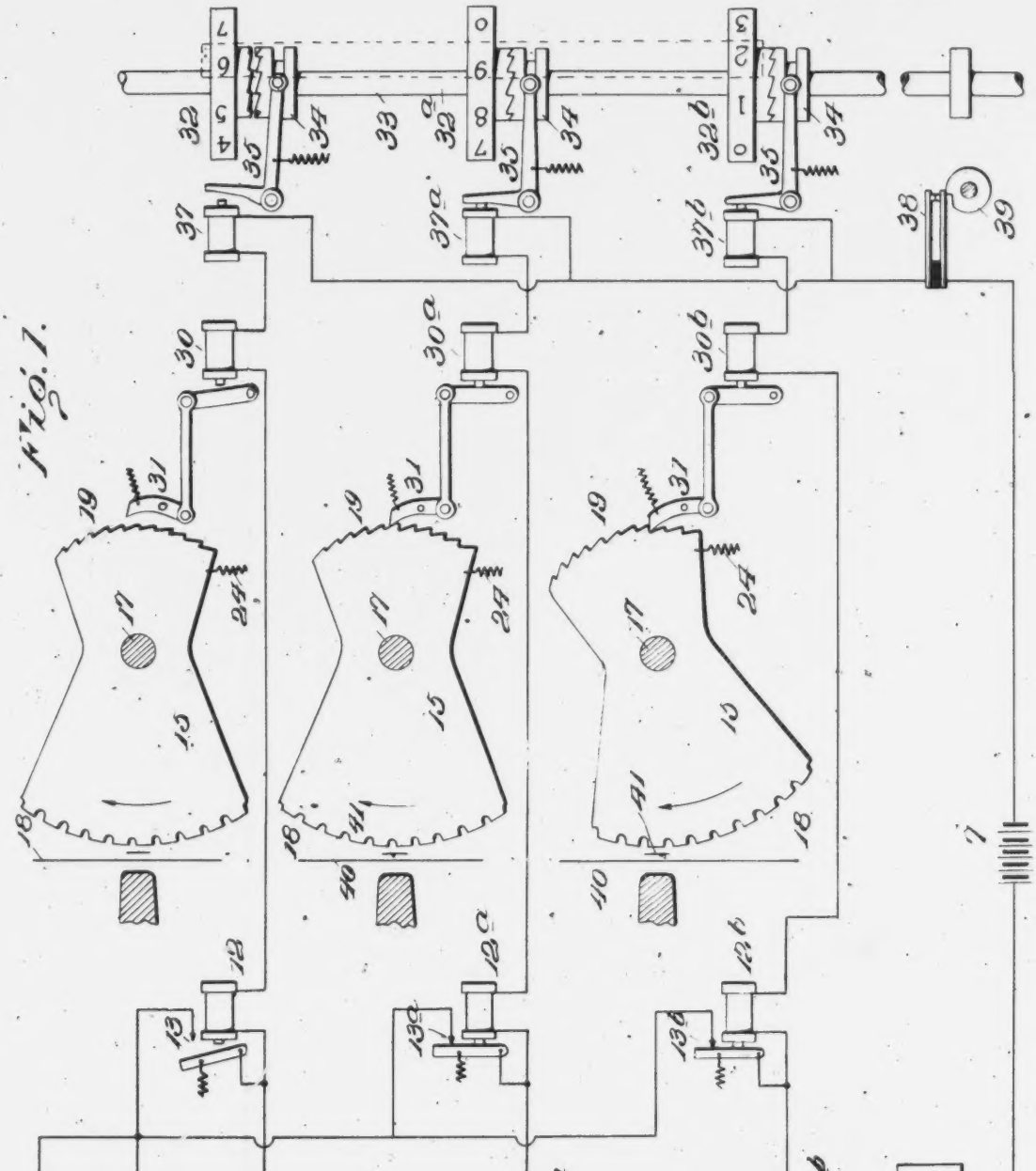
REGISTERING AND RECORDING APPARATUS FOR TABULATING SYSTEMS.

APPLICATION FILED MAR. 26, 1913.

1,295,167.

Patented Feb. 25, 1919.

3 SHEETS—SHEET 1.



3 SHEETS—SHEET 1.

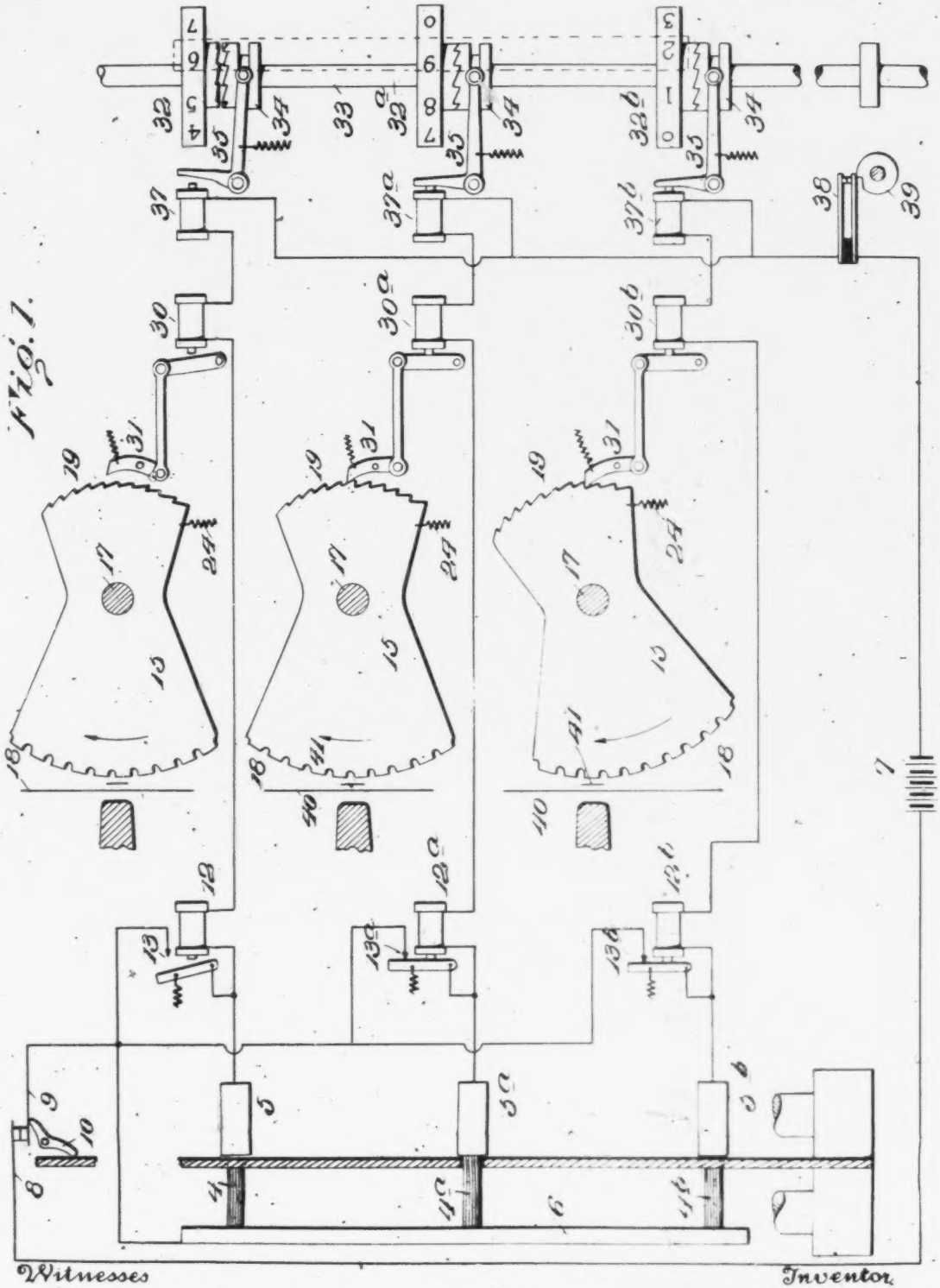


Fig. 1.

Witnesses
R. Abramson
W. A. Williams

Inventor
By Herman Hollerith
A. Stetson Wilson Attorney

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H. HOLLERITH.

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3 SHEETS—SHEET 2.

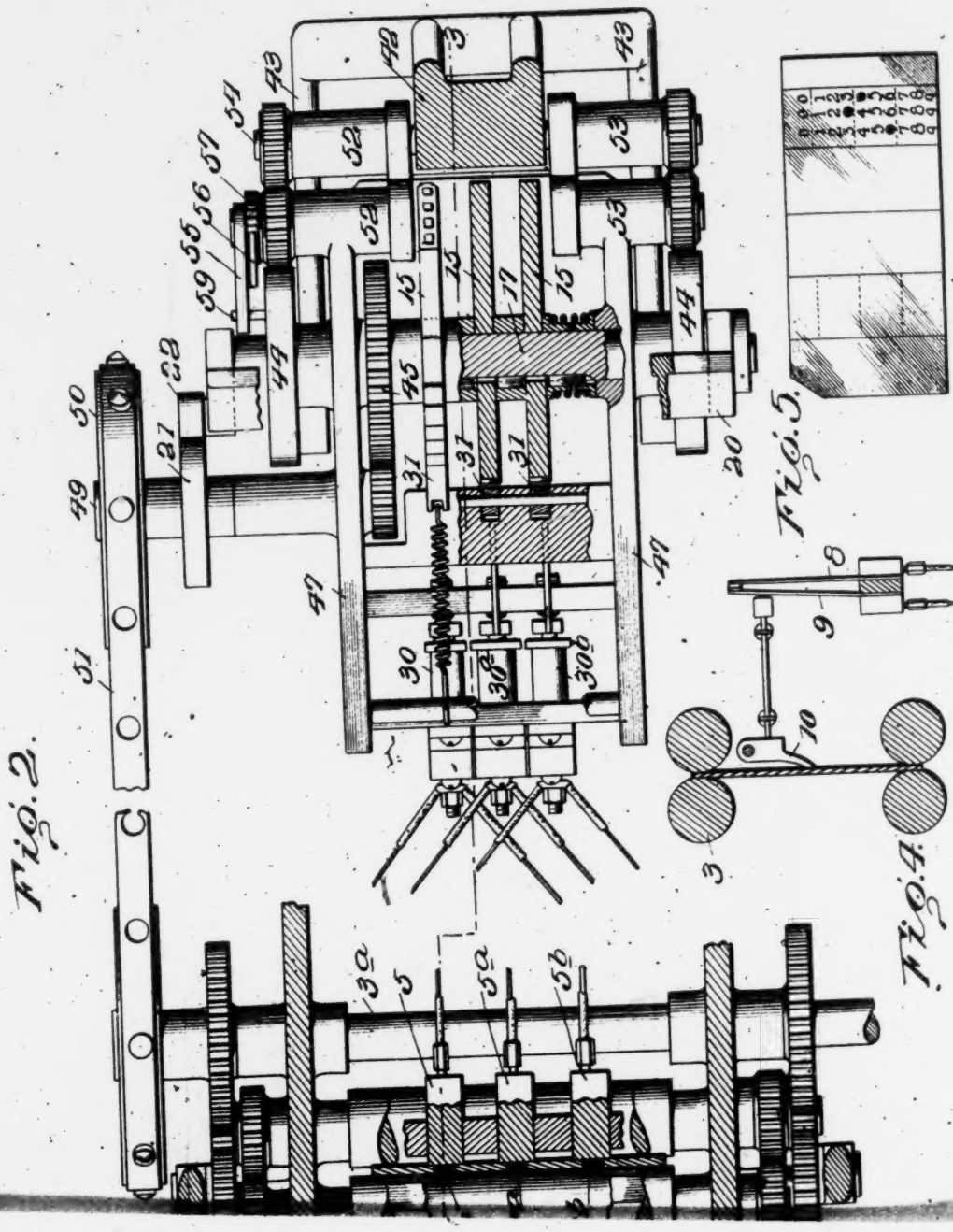

Fig. 2.

Fig. 5.

Fig. 4.

Witnesses

N. Abramson.

W. A. Williams

Inventor

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77

H. HOLLERITH.

REGISTERING AND RECORDING APPARATUS FOR TABULATING SYSTEMS.

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1,295,167.

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3 SHEETS—SHEET 3.

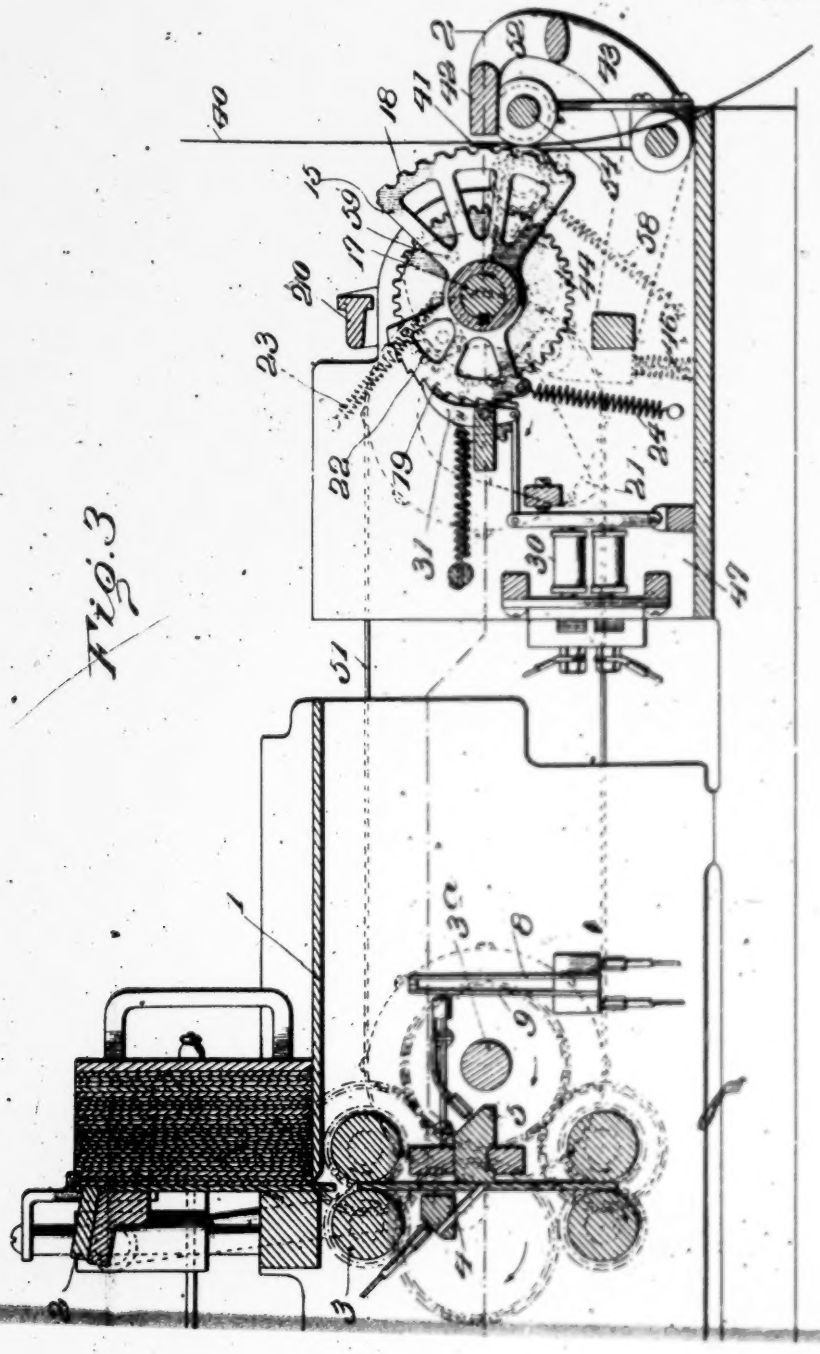

Fig. 3

3 SHEETS—SHEET 3.

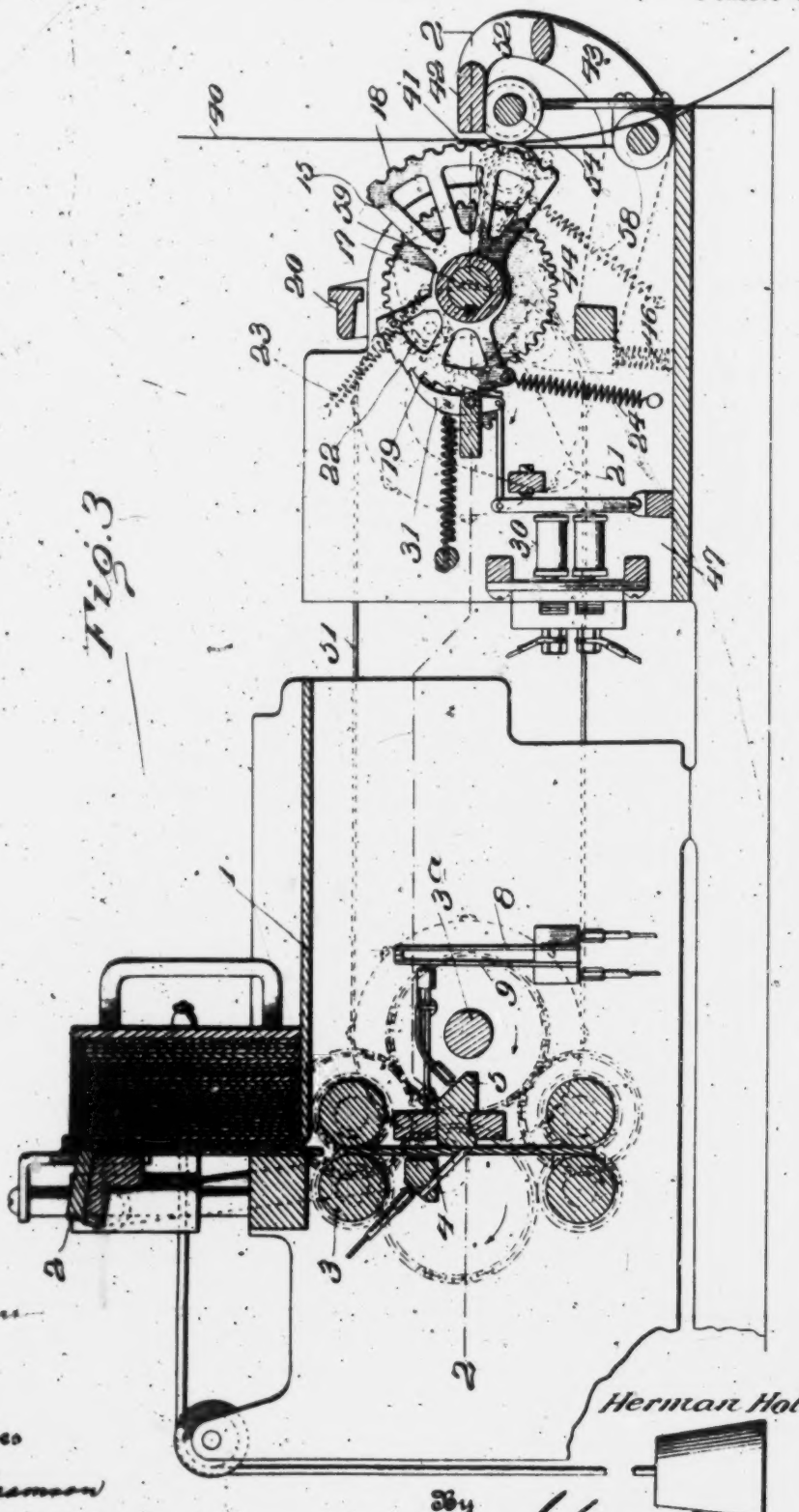

Fig. 3

Witnesses
R. Abramson
W. A. Williams

Inventor
Herman Hollerith

By

Attorney

UNITED STATES PATENT OFFICE.

HERMAN HOLLERITH, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR TO THE TABULATING MACHINE COMPANY, OF EAST ORANGE, NEW JERSEY, A CORPORATION OF NEW JERSEY.

REGISTERING AND RECORDING APPARATUS FOR TABULATING SYSTEMS.

1,295,167. Specification of Letters Patent. Patented Feb. 25, 1919.

Application filed March 26, 1913. Serial No. 757,000.

To all whom it may concern:

Be it known that I, HERMAN HOLLERITH, of Washington, District of Columbia, have invented certain new and useful Improvements in Registering and Recording Apparatus for Tabulating Systems; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The primary object of this invention is to provide in a tabulating system simple and highly efficient means for recording or recording and registering the numbers indicated by a series of index-points on record-cards.

The invention is especially adapted for use in connection with the class of record-cards employed in the Hollerith tabulating system, such index-points being indicated by punched holes at the proper index-point positions on each particular record-card in accordance with the data which that card represents. By means of my present invention the recording will be automatically controlled synchronously with the actuation of the registering device by the corresponding index-point of each record-card.

The recording means comprises a series of type-carrying members arranged to move in unison in opposite directions, each being capable of being independently arrested at any point in its travel in one direction without interfering with the others, the arrest of a type-carrying member being automatically accomplished in accordance with the index-point in the respective column of a record-card.

In the accompanying drawings, Figure 1 is a diagrammatic view of the recording and registering mechanism, illustrating the invention; Fig. 2 is a detail view of the recording mechanism; Fig. 3 is a detail view of the registering mechanism; Fig. 4 is a detail view of the means for controlling the recording mechanism; Fig. 5 is a detail view of the means for controlling the registering mechanism; Fig. 6 is a detail view of the means for controlling the registering mechanism; Fig. 7 is a detail view of the means for controlling the registering mechanism; Fig.

Application filed March 26, 1913. Serial No. 757,000.

To all whom it may concern:

Be it known that I, HERMAN HOLLERITH, of Washington, District of Columbia, have invented certain new and useful Improvements in Registering and Recording Apparatus for Tabulating Systems; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

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In the accompanying drawings, Figure 1 is a diagrammatic view. Fig. 2 is a horizontal sectional view on line 2—2, Fig. 3, the registering device being omitted. Fig. 3 is a vertical longitudinal sectional view on line 3—3, Fig. 2. Fig. 4 is a section in detail. Fig. 5 is a face view of a record-card.

In the form of record-card which I have selected for illustrating and describing my invention, but without intending to limit myself thereto, the index-point positions, as shown in Fig. 5, are denoted by printed figures arranged in groups, each group consisting of one or more columns of figures comprising the nine digits and the cipher, substantially as shown in my U. S. Letters Patent No. 777,209, with the cipher at the top of each column in horizontal alinement, and the digits following in order down each column to the figure "9." To secure brevity in this description I have indicated index-points in only three columns of one group, since the recording means and the registering means which I have selected for illustrating my invention are shown as composed each of only three members, but in actual practice the record-card may contain any desired number of columns of index-point positions with a corresponding number of members of the recording and registering means.

The record-cards are preferably placed on edge, with the cipher at the top, upon a platform 1 and are fed, one by one, to the action of record-actuated contacts by a reciprocating cross-head 2 and feed-rollers 3, in gear with the main operating shaft 3^a. As the feeding mechanism shown is substantially similar to that described in my U. S. Letters Patent No. 945,236, further description thereof is unnecessary. Conducting brushes 4, 4^a and 4^b, are normally in contact with plates 5, 5^a, and 5^b, insulated from each other, but the brushes and their contact plates are separated when a card is fed between them. Each brush and its respective plate form a pair of electrical contacts, which are actuated or permitted to come together and move apart, by the record. When a card is fed between the brushes and the contact plates, the index-point positions of each column of the group to which the contact brushes apply, are presented successively to the brushes or record-actuated devices, and when the punched hole in a column registers with the brush of that column, the brush will contact with its complementary member, and an electrical contact will be established momentarily and the corresponding registering device will be operated in the manner well-known in connection with the tabulating registers of the Hollerith system, and according to my present invention means for controlling the recording mechanism will likewise be operated in synchronism with the registering device. The brushes are mounted on a common plate 6 which is energized when a punched hole registers with a brush, being placed in circuit with a battery 7 in the main circuit. The time at which the record-actu-

ated devices are thus actuated to establish contact through a punched hole, depends upon the location of the punched hole constituting the index-point, and in order that the circuit shall be established initially only through these contacts I provide a contact which will hold the circuit open at another point at all times when no card is between the brushes and their complementary contact plates, as for instance during the period which elapses between the passage of successive cards. This contact is shown in Figs. 1, 3 and 4 as consisting of two opposed spring arms 8 and 9 which are controlled by a lever 10 with which the record-cards engage to complete the main circuit. The contact plates, 5, 5ª and 5ᵇ are separately connected in a secondary circuit with relay magnets 12, 12ª and 12ᵇ, the armatures of which, when the magnets are energized, will close the secondary circuit by engaging contacts 13, 13ª and 13ᵇ, after the manner contemplated by my before noted Patent No. 945,236.

The recording apparatus comprises a series of type-carrying members 15 each of which is shown in the form of a double sector loosely mounted on a common shaft 17, upon which they are designed to reciprocate. On their outer edges these sectors carry type 18 ranging from 0 to 9, while their inner edges are equipped with a corresponding number of ratchet teeth 19. These type-carrying members are all moved in one direction, namely, to the starting point, by a bail 20 which rocks on shaft 17 and is operated by a cam 21 acting on a roll 22 of the bail once in each cycle of operation. To the bail is connected a spring 23 (see Fig. 3), by which its return is effected. Each of the type-carrying members has connected thereto a spring 24 by which said members are moved on the shaft, following the bail on its return travel.

Within the electric circuit, and connected with the relay magnets, is a series of control-magnets 30, 30ª and 30ᵇ. When a relay magnet is energized, its respective control magnet will actuate a pawl 31 and cause it to engage one of the teeth of the respective type-carrying member and arrest the travel there-

typical form of registering apparatus; but their number may, of course, be varied, as desired. Any desired form of registering apparatus embodying directly actuated registering members with means for carrying or transferring from one member to that of the next higher order, accumulating members and zero resetting devices may be employed, and I have therefore not considered it necessary to illustrate or describe the same in detail since their construction and operation are well understood by those skilled in the art.

In the registering apparatus, 32 indicates the units wheel, 32ª the tens wheel, and 32ᵇ the hundreds wheel, and through a suitable sight-opening, (indicated by dotted lines), only one number of each wheel is exhibited. Each wheel is mounted loosely on the shaft 33 which is constantly driven at a uniform speed in synchronism with the moving card and the travel of the recording mechanism. The wheels are suitably supported so that the turning movement of the shaft 33 will not actuate them until they are brought into positive connection therewith. Each of said wheels is provided with a series of peripheral numbers from 0 to 9, and in the form of apparatus illustrated this connection of the wheels with the shaft 33 is effected by means of a clutch, comprising a series of clutch teeth, one for each figure, on the wheels, and coöperating clutch members or disks 34, splined so they will slide on the shaft and turn therewith. Each clutch disk is provided with clutch teeth which will engage the clutch teeth on its registering wheel when it is moved toward the wheel, locking the wheel and disk together so that the wheel will turn with the disk and make the necessary partial revolution.

The clutch members are engaged by spring-held pawls 35, forming the armatures of a third series of magnets 37, 37ª and 37ᵇ which are connected with the control magnets of the recording mechanism and with the main or battery circuit through contacts 38 which are arranged to be separated to break the main circuit simultaneously through all the magnets by a constantly revolving cam 39 at the instant the advancing movement of the card brings the index-point

the brushes and their complementary contact plates, as for instance during the period which elapses between the passage of successive cards. This contact is shown in Figs. 1, 3 and 4 as consisting of two opposed spring arms 8 and 9 which are controlled by a lever 10 with which the record-cards engage to complete the main circuit. The contact plates, 5, 5ª and 5ᵇ are separately connected in a secondary circuit with relay magnets 12, 12ª and 12ᵇ, the armatures of which, when the magnets are energized, will close the secondary circuit by engaging contacts 13, 13ª and 13ᵇ, after the manner contemplated by my before noted Patent No. 945,236.

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Within the electric circuit, and connected with the relay magnets, is a series of control-magnets 30, 30ª and 30ᵇ. When a relay magnet is energized, its respective control magnet will actuate a pawl 31 and cause it to engage one of the teeth of the respective type-carrying member and arrest the travel thereof under the recoil of its spring. The moment of arresting a type-carrying member is controlled by the index-point of the respective column of the record-card, the type of the member in operative position at the time such member is arrested corresponding to the number represented by such index-point.

The registering devices adapted to be operated according to the location of the index-points on the record card comprise a register wheel or member and suitable driving means therefor, such as a clutch disk. Three such register wheels 32, 32ª and 32ᵇ are illustrated in Fig. 1 which is intended to illustrate a

ployed, and I have therefore not considered it necessary to illustrate or describe the same in detail since their construction and operation are well understood by those skilled in the art.

In the registering apparatus, 32 indicates the units wheel, 32ª the tens wheel, and 32ᵇ the hundreds wheel, and through a suitable sight-opening, (indicated by dotted lines), only one number of each wheel is exhibited. Each wheel is mounted loosely on the shaft 33 which is constantly driven at a uniform speed in synchronism with the moving card and the travel of the recording mechanism. The wheels are suitably supported so that the turning movement of the shaft 33 will not actuate them until they are brought into positive connection therewith. Each of said wheels is provided with a series of peripheral numbers from 0 to 9, and in the form of apparatus illustrated this connection of the wheels with the shaft 33 is effected by means of a clutch, comprising a series of clutch teeth, one for each figure, on the wheels, and coöperating clutch members or disks 34, splined so they will slide on the shaft and turn therewith. Each clutch disk is provided with clutch teeth which will engage the clutch teeth on its registering wheel when it is moved toward the wheel, locking the wheel and disk together so that the wheel will turn with the disk and make the necessary partial revolution.

The clutch members are engaged by spring-held pawls 35, forming the armatures of a third series of magnets 37, 37ª and 37ᵇ which are connected with the control magnets of the recording mechanism and with the main or battery circuit through contacts 38 which are arranged to be separated to break the main circuit simultaneously through all the magnets by a constantly revolving cam 39 at the instant the advancing movement of the card brings the index-point positions, denoted by the ciphers, under the brushes. When any one of the control magnets of the recording mechanism is energized, the corresponding control-magnet of the registering device will also be energized, and its armature will be attracted and thereby carry its respective clutch disk into locking engagement with its register wheel. The energizing of both magnets is established by the closing of the circuit by the record-actuated contacts and will be maintained after such contacts are separated, by the circuit established through the relay mag-

nets until the circuit is broken at the contacts 38.

The strip of paper upon which the numbers are to be recorded is indicated at 40, Figs. 1 and 3, and is shown as passing vertically in proximity to the type of the recording members. Between the paper and the type an inking ribbon is conventionally shown at 41, Figs. 1 and 2. I have not indicated the spools upon which the paper is wound or the means for controlling the inking ribbon, as the same may be of any preferred form of construction. After a record-card has passed from control-position, the imprint of the type of the respective recording members corresponding to the index-points is effected by the actuation of a striker 42 which is shown as carried by two levers 43 which are actuated by cams 44. These cams are shown as having three proud portions (Fig. 3) since they make one complete revolution to three cycles of operation of the press, being actuated by reducing gearing 45 (see Fig. 2). Springs 46, one of which is shown in Fig. 3, serve to hold the striker in its normal position.

The striker-actuating cams 44 are fast on shaft 17 which extends transversely of and is supported by the side members of the frame 47. On this shaft is mounted one of the wheels of the reducing gearing 45, the driving member of which is mounted on the operating shaft 49 whereon is shown a toothed wheel 50 driven by a perforated belt 51 leading from a second toothed wheel on the main operating shaft 3ª of the card feed-mechanism. It is manifest that the recording apparatus may be otherwise actuated and need not necessarily be geared to the feed-mechanism. The shaft 49 also carries the bail-actuating-cam 21.

The strip of paper is fed through the recording field by feed rolls arranged in pairs 52, 53, with the type-carrying members between them. The rolls of each pair are geared together, and one roll of each pair is mounted on a common shaft 54 so that power applied to one pair of feed rolls will be transmitted to the other pair. This shaft 54 is outside the plane of the strip of paper, and is beneath the striker, which latter is bent or curved to extend over the shaft. Any suitable means may be employed for imparting an intermittent movement to the

In operation, the cards are fed one at a time from the platform and are caused to pass downwardly between the brushes and their contact plates. As a card is traveling downward the type-carrying ends of the recording members are moving upward under the recoil of their springs, following, in their upward movement, the return bail against which they bear. At the instant the lower end of the card passes between the brushes and their contact plates the spring contact arms 8 and 9 are brought into engagement by the contact of the card with the lever 10, thus closing the circuit at this point. As the card advances to bring the index-point positions denoted by the numerals "9" of the several columns in horizontal alinement under the brushes the lowermost teeth of the series of teeth 19 of the type-carrying members will be adjacent to the stop pawls, while the uppermost type will be in line with the striker, and immediately back of the inking ribbon. If contact is made by any one of the brushes, say the brush 4, by reason of a hole punched at the index-point position "9", the circuit will be immediately closed through such brush 4 and its respective contact plate 5, resulting in the energizing of the relay-magnet 12 and the respective control-magnets 30 and 37 of the recording mechanism and the registering device, respectively, thereby throwing the pawl of the recording mechanism into position to arrest the movement of the respective recording member so that the type "9" thereof will be held in line with the striker, and the clutch member or disk 34 will be thrown into engagement with the register wheel 32 after the manner contemplated in my Patent No. 945,236. As the card advances the remaining recording members will be correspondingly advanced or turned by their several springs, and as the circuit is closed through the index-points of the remaining columns, the respective type-carrying members and registers will be similarly acted upon. The circuit will be broken at the contacts 38 by the cam 39 when the cipher or zero index-point positions reach the brushes. By the time the index-point positions of the card have passed beyond the brushes the striker will be actuated by the cams 44 and the impression made on the strip of paper 40. Before the next cycle

type and inking ribbon is conventionally shown at 41, Figs. 1 and 2. I have not indicated the spools upon which the paper is wound or the means for controlling the inking ribbon, as the same may be of any preferred form of construction. After a record-card has passed from control-position, the imprint of the type of the respective recording members corresponding to the index-points is effected by the actuation of a striker 42 which is shown as carried by two levers 43 which are actuated by cams 44. These cams are shown as having three proud portions (Fig. 3) since they make one complete revolution to three cycles of operation of the press, being actuated by reducing gearing 45 (see Fig. 2). Springs 46, one of which is shown in Fig. 3, serve to hold the striker in its normal position.

The striker-actuating cams 44 are fast on shaft 17 which extends transversely of and is supported by the side members of the frame 47. On this shaft is mounted one of the wheels of the reducing gearing 45, the driving member of which is mounted on the operating shaft 49 whereon is shown a toothed wheel 50 driven by a perforated belt 51 leading from a second toothed wheel on the main operating shaft 3ª of the card feed-mechanism. It is manifest that the recording apparatus may be otherwise actuated and need not necessarily be geared to the feed-mechanism. The shaft 49 also carries the bail-actuating-cam 21.

The strip of paper is fed through the recording field by feed rolls arranged in pairs 52, 53, with the type-carrying members between them. The rolls of each pair are geared together, and one roll of each pair is mounted on a common shaft 54 so that power applied to one pair of feed rolls will be transmitted to the other pair. This shaft 54 is outside the plane of the strip of paper, and is beneath the striker, which latter is bent or curved to extend over the shaft. Any suitable means may be employed for imparting an intermittent movement to the feed rolls to cause the paper to be fed after each impression. On the shaft of one of the feed rolls 52 is loosely mounted an arm 55 which carries a pawl 56 which is designed to engage a ratchet 57 on said shaft, a spring 58 (see Fig. 3) tending to hold the pawl in engagement with the ratchet. The pawl-carrying arm 55 when engaged by any one of three pins 59 extending laterally from the adjacent cam 44 will impart the necessary movement to the feed rolls.

their upward movement, the return bail against which they bear. At the instant the lower end of the card passes between the brushes and their contact plates the spring contact arms 8 and 9 are brought into engagement by the contact of the card with the lever 10, thus closing the circuit at this point. As the card advances to bring the index-point positions denoted by the numerals "9" of the several columns in horizontal alinement under the brushes the lowermost teeth of the series of teeth 19 of the type-carrying members will be adjacent to the stop pawls, while the uppermost type will be in line with the striker, and immediately back of the inking ribbon. If contact is made by any one of the brushes, say the brush 4, by reason of a hole punched at the index-point position "9", the circuit will be immediately closed through such brush 4 and its respective contact plate 5, resulting in the energizing of the relay-magnet 12 and the respective control-magnets 30 and 37 of the recording mechanism and the registering device, respectively, thereby throwing the pawl of the recording mechanism into position to arrest the movement of the respective recording member so that the type "9" thereof will be held in line with the striker, and the clutch member or disk 34 will be thrown into engagement with the register wheel 32 after the manner contemplated in my Patent No. 945,236. As the card advances the remaining recording members will be correspondingly advanced or turned by their several springs, and as the circuit is closed through the index-points of the remaining columns, the respective type-carrying members and registers will be similarly acted upon. The circuit will be broken at the contacts 38 by the cam 39 when the cipher or zero index-point positions reach the brushes. By the time the index-point positions of the card have passed beyond the brushes the striker will be actuated by the cams 44 and the impression made on the strip of paper 40. Before the next cycle of operation the paper is advanced through the actuation of the feed rolls. As the cam 21 engages the bail all the recording members will be returned to their starting point, the action of the bail on the several members being discontinued and the bail starting on its return movement under the recoil of its spring by the time the first index-point positions of the next record-card are in the field of control of the contact terminals.

While I have shown and described elec-

trically-operated means for effecting the control of the apparatus, yet it is not my intention to restrict my invention to the employment of electricity, since other equivalent means may be employed instead of an electric circuit or circuits and electrically-operated devices; but I consider electricity to be the most advantageous agent and have therefore selected, for the purpose of description, an electrically-operated apparatus, and in this connection it is to be understood that where electricity is employed as an actuating or controlling agent the apparatus may be arranged for operation either on open or closed circuits.

I claim as my invention:

1. In apparatus of the character described, in combination, recording mechanism having normally active recording members, a record-card, means whereby the record card may be moved continuously through the machine, and means controlled by the record-card for arresting said members during the movement of the card.

2. In apparatus of the character described, in combination, a series of normally active recording members, a record-card, means whereby the record card may be moved continuously through the machine, means for separately arresting said members during the movement of the card, and record actuated means for controlling said arresting means.

3. In apparatus of the character described, in combination, recording mechanism having normally active recording members, an electric circuit, electro-magnets in said circuit, a record-card having index-point positions and moving in synchronism with said recording members, means actuated by the index-points for controlling said magnets, and means actuated by said magnets for arresting said members.

4. In apparatus of the character described, the combination with a registering device, of recording mechanism having normally active recording members, means for arresting said members, and means common to said registering device and said arresting means for automatically controlling the same.

5. In apparatus of the character described, the combination with a registering device and controlling means therefor, of recording mechanism having normally active recording members, means actuated in synchronism with said controlling means for arresting said members, and means for controlling the same.

6. In apparatus of the character described, the combination with a registering device and controlling means therefor, of recording mechanism having normally active recording members, means actuated in synchronism with said controlling means for arresting said members, an electric circuit common to said register controlling means and said arresting means for controlling the same, and means for controlling such circuit.

7. In apparatus of the character described, the combination with a registering device and controlling means therefor, of recording mechanism having normally active recording members, means actuated in synchronism with said registering device for arresting said members, and a record-card moving in synchronism with said recording members for controlling said controlling means and said arresting means.

8. In apparatus of the character described, in combination, recording mechanism having normally active recording members, a record-card, means whereby the record card may be moved continuously through the machine, means controlled by the record-card for arresting said members during the movement of the card, and a printing element for coöperating with said recording members after the latter have been arrested.

9. In apparatus of the character described, the combination with a registering device and controlling means therefor, of recording mechanism having normally active type-carrying members, a record-card moving in synchronism with said recording members, means controlled by the record-card in synchronism with said controlling means for automatically arresting said members, and a printing element for coöperating with said type-carrying members after the latter have been arrested.

10. In apparatus of the character described, the combination with a registering device and controlling means therefor, of recording mechanism having normally active type-carrying members, means actuated in synchronism with said register controlling means for arresting said members, and a printing element for coöperating with said type-carrying members after the latter have been arrested.

11. In an apparatus of the character described, in combination, a series of recording

ratus, and in this connection it is to be understood that where electricity is employed as an actuating or controlling agent the apparatus may be arranged for operation either on open or closed circuits.

I claim as my invention:

1. In apparatus of the character described, in combination, recording mechanism having normally active recording members, a record-card, means whereby the record card may be moved continuously through the machine, and means controlled by the record-card for arresting said members during the movement of the card.

2. In apparatus of the character described, in combination, a series of normally active recording members, a record-card, means whereby the record card may be moved continuously through the machine, means for separately arresting said members during the movement of the card, and record actuated means for controlling said arresting means.

3. In apparatus of the character described, in combination, recording mechanism having normally active recording members, an electric circuit, electro-magnets in said circuit, a record-card having index-point positions and moving in synchronism with said recording members, means actuated by the index-points for controlling said magnets, and means actuated by said magnets for arresting said members.

4. In apparatus of the character described, the combination with a registering device, of recording mechanism having normally active recording members, means for arresting said members, and means common to said registering device and said arresting means for automatically controlling the same.

5. In apparatus of the character described, the combination with a registering device and controlling means therefor, of recording mechanism having normally active recording members, means actuated in synchronism with said controlling means for arresting said members, and means common to said register controlling means and said arresting means for automatically controlling the same.

6. In apparatus of the character described, the combination with a registering device and controlling means therefor, of recording mechanism having normally active recording members, means actuated in synchronism with said registering device for arresting said members, and a record-card moving in synchronism with said recording members for controlling said controlling means and said arresting means.

8. In apparatus of the character described, in combination, recording mechanism having normally active recording members, a record-card, means whereby the record card may be moved continuously through the machine, means controlled by the record-card for arresting said members during the movement of the card, and a printing element for coöperating with said recording members after the latter have been arrested.

9. In apparatus of the character described, the combination with a registering device and controlling means therefor, of recording mechanism having normally active type-carrying members, a record-card moving in synchronism with said recording members, means controlled by the record-card in synchronism with said controlling means for automatically arresting said members, and a printing element for coöperating with said type-carrying members after the latter have been arrested.

10. In apparatus of the character described, the combination with a registering device and controlling means therefor, of recording mechanism having normally active type-carrying members, means actuated in synchronism with said register controlling means for arresting said members, and a printing element for coöperating with said type-carrying members after the latter have been arrested.

11. In an apparatus of the character described, in combination, a series of recording members, springs connected each to said members for moving them in one direction, a bail designed to engage all of said members for moving them in one direction, a constantly-rotating cam for actuating said bail to return said members to their starting point, a record-card having index-point positions, and means for separately arresting said recording members.

12. In an apparatus of the character described, in combination, a series of recording members, a common support upon which said members are loosely mounted, each

member being in the form of a double sector and having a series of type and a series of ratchet teeth at opposite ends, springs for moving the members in one direction, an element common to all of the members for moving them in the opposite direction, a record-card having index-point positions, a series of pawls, one for each recording member, for separately arresting such members, and a striker designed to coöperate with the type when the recording members are at rest.

13. In an apparatus of the character described, in combination, a series of recording members, a shaft upon which said members are loosely mounted, springs connected to said members for moving them in one direction, a bail mounted concentrically to said recording members for moving all of them in opposition to said springs, an operating shaft, a cam carried by said operating shaft for actuating said bail in each cycle of operation, a cam loose on the first mentioned shaft, reducing gearing between said cam and the operating shaft, and a striker for coöperating with the recording members actuated by said cam once in each cycle of operation.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

HERMAN HOLLERITH.

Witnesses:
JULIUS V. PATROSSO,
FRANCIS S. MAGUIRE.

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AUTOMATIC CONTROL FOR TABULATING MACHINES

Filed March 11, 1914 4 Sheets-Sheet 1

Fig. 1.

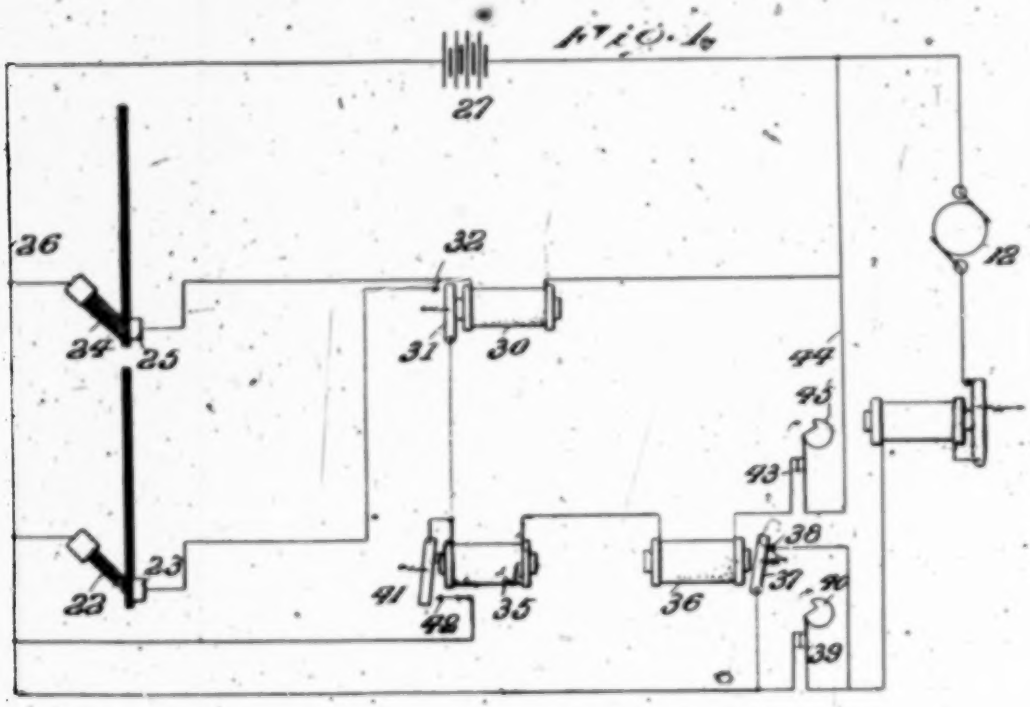
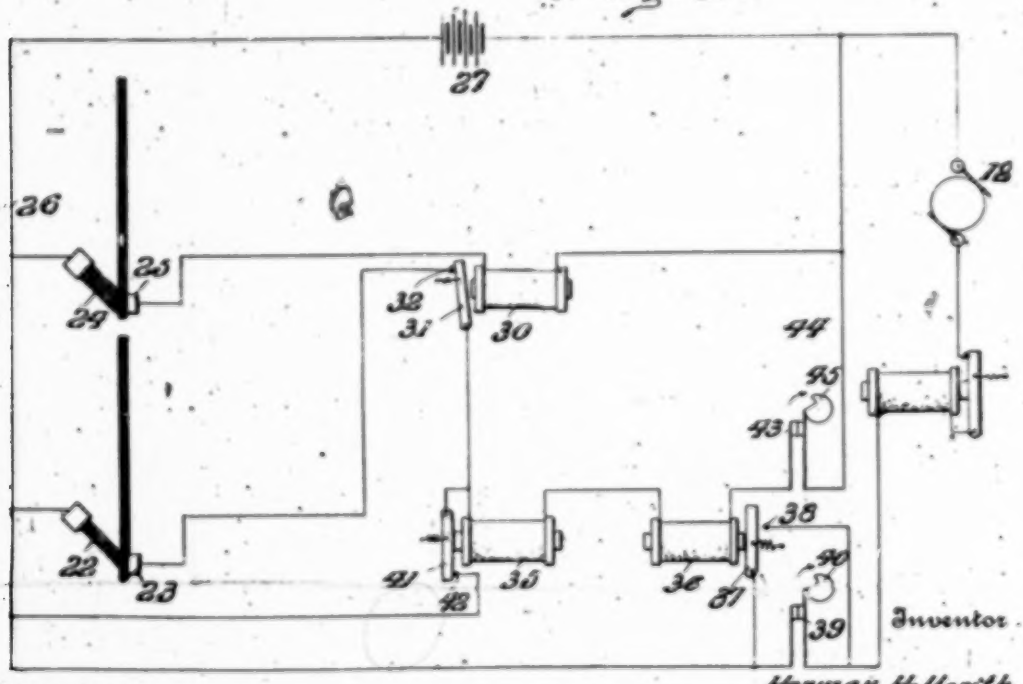


Fig. 2.



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AUTOMATIC CONTROL FOR TABULATING MACHINES

Filed March 11, 1914 4 Sheets-Sheet 2

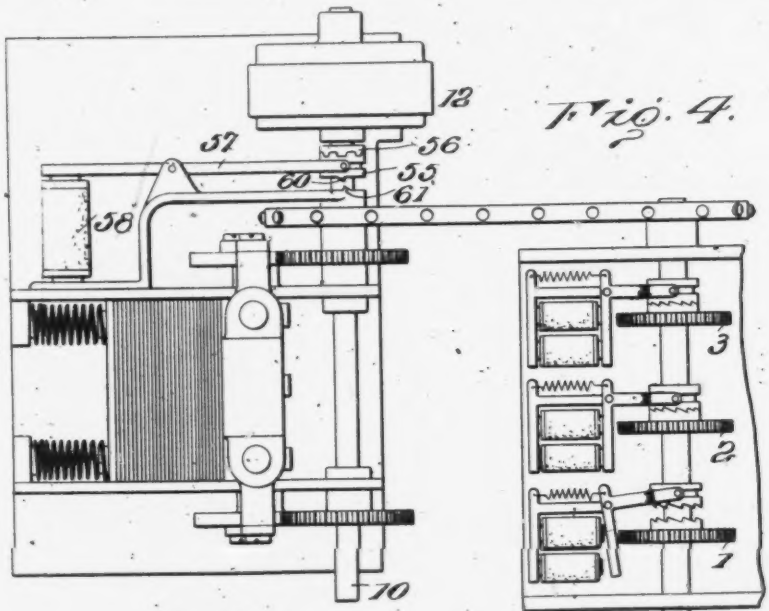

Fig. 4.

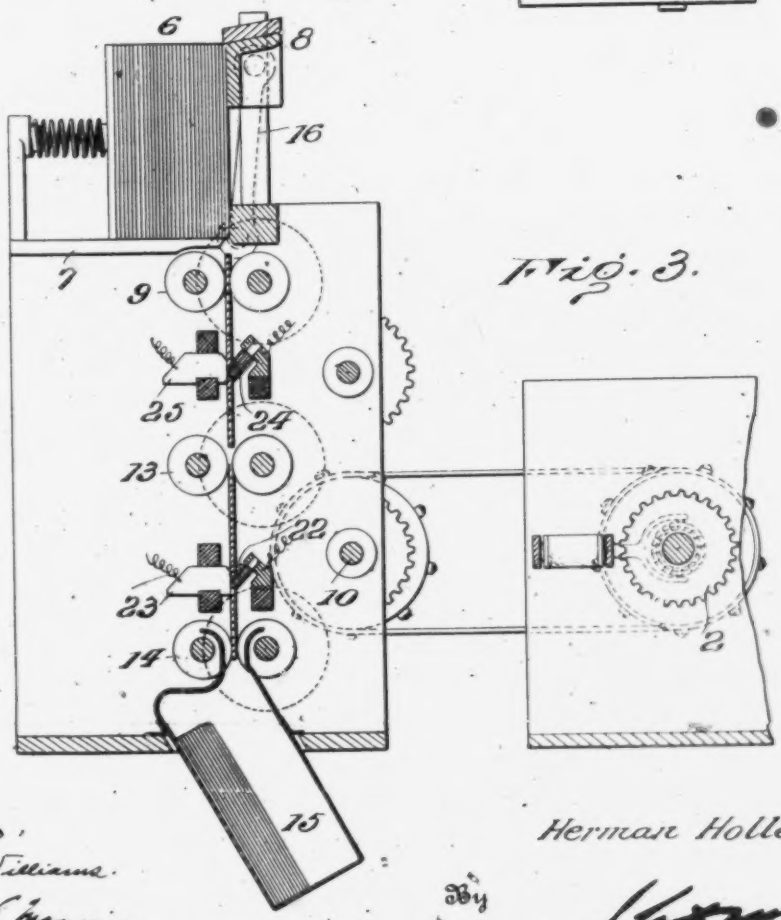

Fig. 3.

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AUTOMATIC CONTROL FOR TABULATING MACHINES

Filed March 11, 1914 4 Sheets-Sheet 3

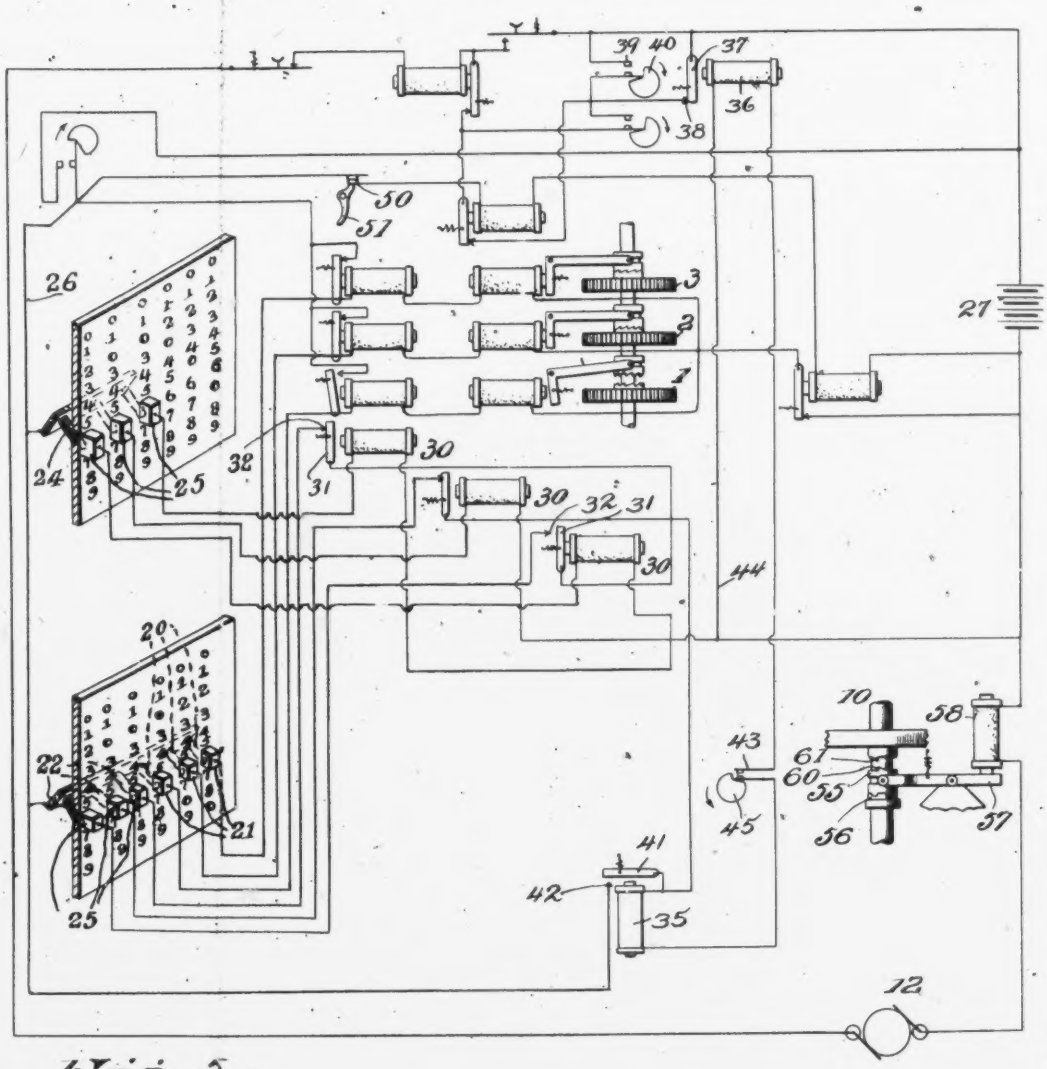

Fig. 5.

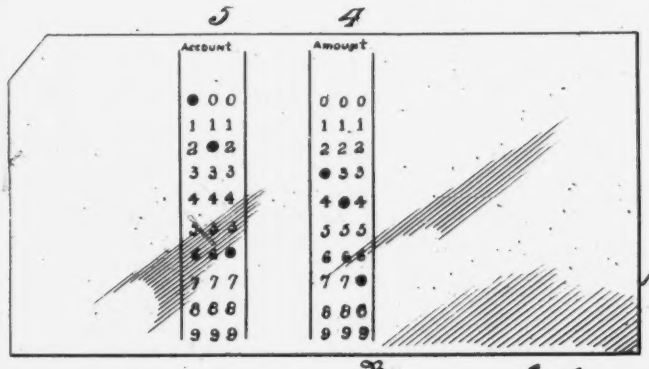

Fig. 6.

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AUTOMATIC CONTROL FOR TABULATING MACHINES

Filed March 11, 1914 4 Sheets-Sheet 4

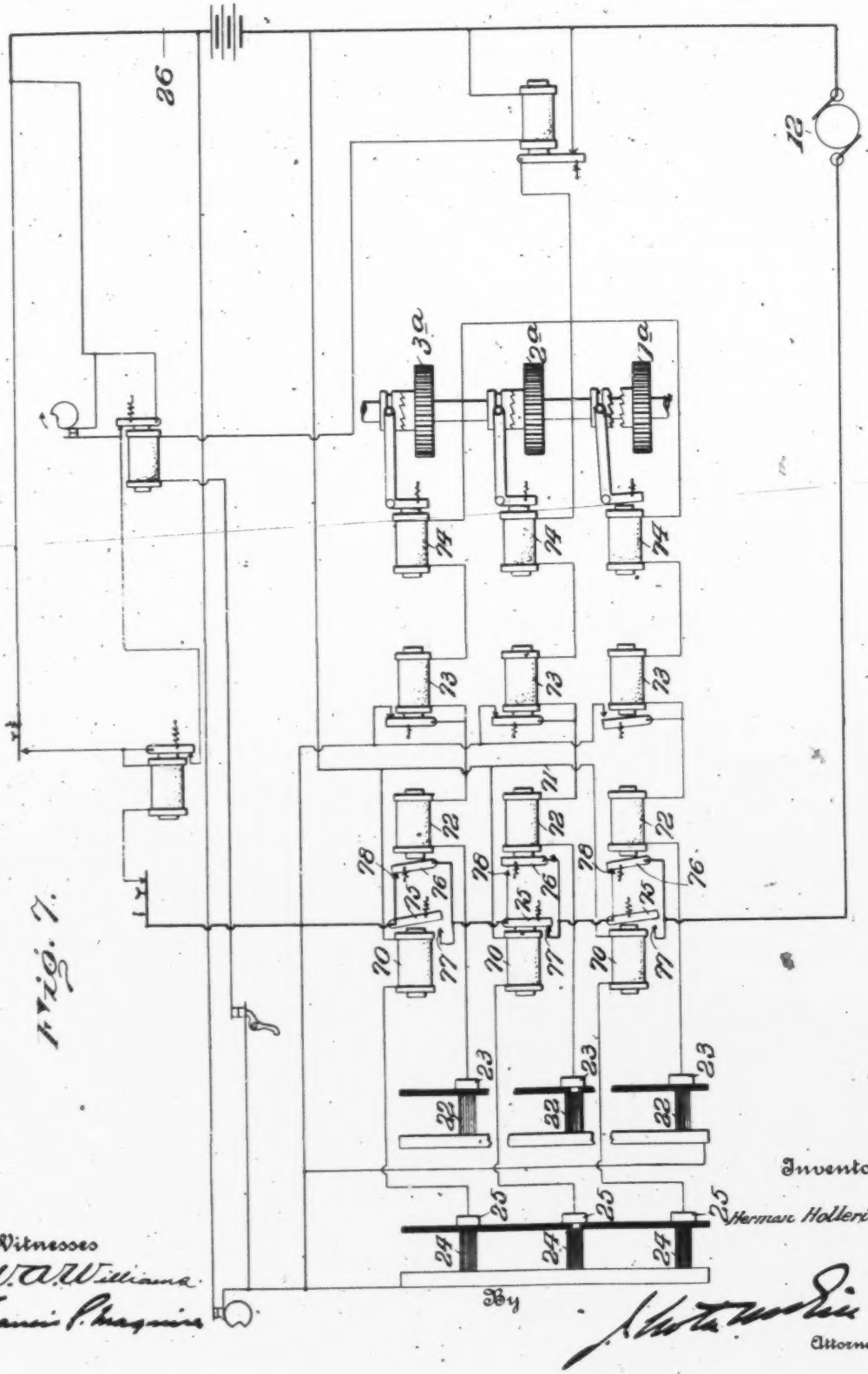

Fig. 7.

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UNITED STATES PATENT OFFICE

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AUTOMATIC CONTROL FOR TABULATING MACHINES

Application filed March 11, 1914. Serial No. 824,015.

The object of this invention is to provide means for automatically controlling registering and other apparatus used in the Hollerith tabulating system in which, as is well known, is employed a record-card having index-points, preferably punched holes, which are located on each particular record-card in accordance with the data which that card represents. The system comprises, among other things, apparatus for registering the items constituting the record formed on each record-card and totalizing or integrating the items of any one or more columns of the record-cards, and also apparatus for sorting or classifying the record-cards into different series.

After the record-cards have been sorted or classified according to a particular class, it is frequently desirable or necessary to totalize or integrate the record represented by the index-points in a corresponding group of all classified record-cards composing several different series of sorted or classified record-cards in the apparatus.

By my present invention I automatically detect a change in a record group of cards, the apparatus, in the form shown herein, being controlled or stopped at the termination of the totalizing or integration of each series or group of sorted or classified record-cards and before a second series of record-cards is brought into controlling relation to the apparatus.

In Letters Patent No. 1,087,061, issued to me February 10, 1914, I showed means for accomplishing this purpose with the aid of stop-cards located between the different series of record-cards, the stop-cards when brought into control position allowing the apparatus to automatically stop. According to my present invention the same result is effected by the record-cards themselves (i. e. the cards upon which the data being tabulated is recorded), without the use of stop cards.

Electricity is the agent preferably employed for effecting the control or operation of the apparatus but it is not my intention to restrict my invention to the employment of that particular operating or controlling agent since other equivalent means may be employed instead of an electric circuit or circuits and electrically operated devices hereinafter described; but I consider electricity to be the most advantageous agent and have therefore selected, for the purpose of description, an electrically-operated apparatus, but it is to be understood that I do not intend to exclude from the scope of this invention apparatus in which some or all of the devices are operated mechanically instead of electrically, and further where the apparatus is operated electrically, either open or closed circuits may be employed.

In the accompanying drawings, Fig. 1 is a diagrammatic view in elevation showing the parts in the position they occupy in the normal operation of the apparatus, with two cards in position both belonging to the same series. Fig. 2 is a similar view showing the parts in position to stop the operation of the apparatus, with two cards in position belonging to different series. Fig. 3 is a vertical longitudinal sectional view, with parts broken away, showing a portion of the tabulating apparatus. Fig. 4 is a plan view of the parts shown in Fig. 3. Fig. 5 is a diagrammatic plan view of a portion of a tabulator with my present improvements added. Fig. 6 is a face view of a record-card. Fig. 7 is a diagrammatic plan view of a modified arrangement, the sets of contacts being offset for the sake of clearness.

In the form of record-card which I have selected for the purpose of illustrating and describing my invention, but without intending to limit my invention thereto, the index-point positions, as shown in Fig. 6, are denoted by printed figures arranged in groups, each group consisting of one or more columns of figures comprising the nine digits and the cipher, substantially as shown in my U. S. Letters Patent No. 677,214 and No. 777,209, with the cipher at the top of each column in horizontal alinement and the digits following in order down each column to the figure 9. As in my before noted Patent No. 1,087,061, I have shown only two groups, each consisting of three columns of index-point positions, but in actual practice the record-card may contain any desired number of

different groups, and each group may embody several columns of index-point positions, but this theoretical form of record will enable the principle of my invention to be readily understood.

There may be any desired number of registers, each controlled by the index-points in its respective group of the record-cards, but the present invention will be described first in reference to a single registering apparatus, registering gears of a typical form of which are shown at 1, 2 and 3 (Fig. 4); but their number may, of course, be varied as desired. Any desired form of registering apparatus embodying directly actuated registering members with means for carrying or transferring from one member to that of the next higher order, accumulating members and zero resetting devices may be employed, and I have therefore not considered it necessary to illustrate or describe the same in detail since their construction and operation are well known in the art. According to the record-card shown by way of illustration the registering device will be controlled by the index-points in group 4, which for present purposes, and solely for enabling the invention to be readily understood, may be regarded as representing the "amount" of a particular record, while the index-points in group 5 may be considered as representing the "account" number against which the amount may be chargeable.

Assuming that the record-cards of a given "account" number have been sorted, or, more properly speaking, that the record-cards of several different accounts have been sorted and classified, and properly positioned in the apparatus to enable the record represented by the index-points in the "amount" group of each series to be totalized or integrated, according to my present invention, the tabulation will be automatically stopped after the last record-card of each series has passed from its control position and the record represented thereby has been indicated by the registering wheels.

The different series of record-cards 6, stacked together, ready to be fed to the apparatus, are placed on edge upon a platform 7, (Fig. 3) and are fed therefrom, one by one, by a reciprocating cross-head 8 and feed-rollers 9 in gear with each other and with the main operating shaft 10 which is designed to be rotated by motor 12. Operating with the feed-rollers 9 are two lower sets of feed-rollers, 13 and 14, on different horizontal planes, and beneath the rollers 14 I have shown a receptacle 15 into which the cards may be discharged after passing through the machine. The cross-head is reciprocated by connecting rods 16 which are actuated in synchronism with the feed-rollers. As is well-known, according to the Hollerith system each record-card in its passage through the apparatus is brought into position to control record-actuated contacts through which the registering devices are controlled, and preferably such contacts consist of conducting brushes and contact plates which are actuated, or permitted to come together and move apart, by the record.

In Fig. 5 I have shown three brushes 20 and three contact plates 21 to which the index-point positions of the respective columns of group 4, in the selected illustration, are successively presented, and when a punched hole in a column registers with a brush of that column the brush will engage its respective contact and an electrical circuit will be established momentarily to control the respective registering wheel of the tabulating apparatus. The means shown for controlling the circuit is substantially that indicated in Letters Patent 945,236 issued to me January 4, 1910, and hence further description thereof is unnecessary.

The index-point positions of the respective columns of group 5 are successively presented to contact brushes 22 and their respective contact plates 23 which control means for stopping the apparatus. So far as concerns contacts 22—23, the index-points of column 5 are in control thereof, while the index-points of column 4 control the contacts 20—21.

The record-cards in addition to controlling the record-actuated contacts 20—21 and 22—23 also control a series of record-actuated contacts composed of brushes 24 and contact-plates 25 to which are presented the same index-point positions by which the contacts 22—23 are controlled, namely, in the selected illustration, the columns of the "account" group 5. These contacts 24—25 are in the path of the record-cards in their passage through the apparatus; they are shown in Figs. 1, 2 and 3 as located above the before described record-actuated contacts and between the upper feed-rollers 9, and the intermediate feed-rollers 13, while the record-actuated contacts 20—21 and 22—23 are between the latter feed-rollers and the lower feed-rollers 14. The purpose of this supplemental series of record-actuated contacts 24—25 is to insure the apparatus remaining in operation while record-cards of the same series are passing through it and to allow the apparatus to automatically stop when cards of a different series are brought into position to control the record-actuated contacts. The contacts 24—25 are adapted to sense the designation of the cards and when such sensing means detects a change in the designation the means for feeding the cards through the apparatus will be brought to a stop.

Referring now to the diagram, Fig. 1, which shows a single set of record-controlled contacts of each of the two series, the con-

tact brushes 22 and 24 are connected to one line of the main operating circuit 26 which includes a generator 27 and the motor 12. The contact plate 25 is connected to a relay magnet 30 which latter is connected to the other line of the main circuit. When the circuit is closed through brush 24 and contact plate 25 the armature 31 of relay magnet 30 will be drawn away from contact 32 with which it is normally in engagement. This contact 32 is connected to the corresponding contact plate 23 of the other series of record-controlled contacts, that is, the series common to the same index-point positions as the contacts 24—25. The armature 31 is connected to a control magnet 35, which in turn is connected to a relay magnet 36, the armature 37 of which is connected to the main circuit and is normally in engagement with a contact 38 of a branch of such main circuit which bridges contacts 39 therein. The latter are arranged to be separated to break the main circuit by a constantly-revolving cam 40. The armature 41 of control magnet 35 is connected with magnet 36 and is shown in series with magnet 35 and connected to armature 31. When magnet 35 is energized by the passing of current through contact point 32 and armature 31 the armature 41 will engage contact 42 connected to the main circuit and the current will then pass from armature 41 through magnet 35 to the magnet 36, armature 41 remaining in such engagement until magnet 35 is de-energized, in a manner to be hereinafter described, so as not to break the operating circuit when contact between brush 22 and contact plate 23 is interrupted by passage of the punched portion of the card from these contact points.

If contact is had concurrently by corresponding brushes 22 and 24 through correspondingly-punched holes in corresponding columns of two record-cards of a common series no circuit will be established between brush 22 and its contact plate 23, for that, synchronously with, or just immediately preceding, the presentation of the punched hole of the forward card to the brush and contact 22—23 the circuit is closed through the corresponding brush and contact 24—25 in time for the magnet 30 to draw its armature 31 from contact 32, and hence the machine will continue in operation.

If, however, as shown diagrammatically in Fig. 2, the punched holes do not correspond, as when the record-cards presented to the two series of contacts belong to different card series, (as represented by the index-point positions in column 5 in the selected illustration) with the result that contact will not exist synchronously between corresponding brushes and their respective contact plates, the armature 31 will be in engagement with contact 32 when the circuit is closed through brush and contact 22—23, resulting in energizing magnets 35 and 36 and the breaking of the main circuit at contact 38. The main circuit will not, however, be completely opened until contacts 39 are separated, and this is arranged to occur at a predetermined point in the operation of the apparatus, namely, during the interval following the passage of one, and the entrance of a succeeding card, into control position between the brushes and contacts 22—23. The magnet 35 will maintain its control over armature 41 until the circuit through such magnet is broken. For this purpose I employ two contacts 43 in conductor 44 between magnet 36 and the main circuit, and these contacts are arranged to be separated by a constantly revolving cam 45, which performs its function simultaneously with, or immediately following, the action of the cam 40. When contacts 43 are separated control magnet 35 is de-energized and its armature 41 released.

The brushes 24 are preferably made wider than the lower brushes 22 so that when two record-cards similarly punched are moving between the brushes and their contact plates the brushes 24 will make contact before, and break contact after, the brushes 22, thus providing for any irregularity in punching.

From what has been said it will be understood that when the circuit is closed through contacts 24, 25 the motor circuit will not be broken, and this is true whether or not any of the lower brushes 22 are in contact with their respective plates 23. If any one of the brushes 22 makes contact with its respective plate 23 and the circuit is not at the same time closed through the corresponding brush and contact 24—25 the magnets 35 and 36 will be energized and the motor circuit broken. If the cards passing through are similarly punched, that is, of a common series, the machine will continue to run, and if no card is between the contacts 24—25, as when the last card of a series has passed to the contacts 22—23, the machine will continue in operation until such last card passes from control position relative to such latter contacts. The main circuit will then open through the disengagement of card-controlled contacts 50 (Fig. 5), when such card moves out of engagement with contact-controlling lever 51 after the manner disclosed in my before noted Patent No. 945,236. This permits the tabulation of the last card of each series.

Any suitable means may be employed for automatically engaging and disengaging the main operating shaft 10 from the motor. I have shown for this purpose a clutch sleeve 55 splined on shaft 10 and having on one side squared teeth for engaging corresponding teeth of a disc 56 on the motor shaft, said sleeve being shiftable longitudinally of the shaft by a spring-held lever 57 which forms the armature of a magnet 58 in the main cir-

cuit so that when the latter is closed lever 57 will shift the clutch to couple shaft 10 to the motor. For the purpose of arresting shaft 10 at the proper point, a single tooth 60 of the clutch is designed to engage a fixed stop or tooth 61, such engagement occurring after the main circuit is opened and the last card of a series has passed through the apparatus.

The electric circuit, as shown in Fig. 5, comprises, in addition to the motor and generator, suitable magnets and relays and starting and stopping contacts not necessary here to be described. In this figure the lowermost magnet 30 is shown in the same position as in Figure 1. The energizing of this magnet and the withdrawal of the armature 31 from contact 32 are caused by the simultaneous presentation of similarly punched holes in the record-cards to the contacts 24—25 and 22—23. When this condition exists the magnet 30 is energized slightly in advance of the engagement between contact 22—23 (the brushes 24, as before described, being wider than the brushes 22) with the result that the machine will continue to run, the mechanism actuated through the control magnet 35 and relay magnet 36 being unaffected. If, however, the punched holes of the cards successively presented to the contacts 24—25 and 22—23 are not similar, the circuit will be established between the contacts 22 of one lead, and the contact plates 23, armature 31, control magnet 35, contacts 43 and relay magnet 36 of the other lead, with the following result: Control magnet 35 will be energized, drawing its armature 41 into engagement with contact 42 and the energization of relay magnet 36 will effect the disengagement of the armature 37 from contact 38, the circuit being broken through contacts 39 by the revolving cam 40 which will effect the stopping of the motor. The control magnet 35 and the relay magnet 36 will be de-energized by the breaking of the contacts 43 effected by the revolving cam 45.

While for the purpose of illustrating and clearly describing my invention, I have selected certain specific means and forms of apparatus in which it is embodied, it is to be understood that the same may be modified in many respects without departing from the principle or spirit of the invention as set forth in the claims.

According to the arrangement above described the means controlled by the two series of contacts 22—23 and 24—25 are located in secondary circuits and the main circuit normally remains unbroken; but according to the arrangement shown diagrammatically in Fig. 7 the controlling means is in the main circuit, and such means may control a separate register which will be operated as each card series comes into control position to indicate, in the selected illustration, the "account" number and which will remain unaltered while cards of a common series are passing through the machine, as specified in my before noted Patent No. 1,087,061.

In Fig. 7 the contact plates 25 are severally connected to relay magnets 70 which are connected by a common conductor 71 to one lead of the main circuit 26, while the co-acting brushes 24 are connected to the other lead of such circuit. The contact plates 23 are severally connected to relay magnets 72 which are connected to a register through relay magnets 73 and clutch magnets 74, gears 1*a*, 2*a* and 3*a* of the register only being shown. The brushes 22 are connected to the same lead of the main circuit as brushes 24, while the magnets of the register are connected to the opposite lead, as are contact plates 25 and magnets 70. The armatures 75 of relay magnets 70 and the armatures 76 of relay magnets 72 control the main circuit which may be closed through either series of armatures. Both series are in the main circuit in branch relation to each other. The armatures 75 are drawn into engagement with contacts 77 when magnets 70 are energized; the armatures 76 are normally in engagement with contacts 78, but drawn therefrom when magnets 72 are energized. If either armature is in engagement with its respective contact the circuit is maintained, but if both armatures are out of engagement with such contacts the circuit is opened. Normally the circuit is maintained through armature 76 and open through armature 75. If companion magnets 70 and 72 are synchronously energized by the closing of the circuits through correspondingly punched holes in two cards of a common series being presented to the respective contacts, the main circuit is maintained through armature 75 and contact 77 and is broken through armature 76 and contact 78. On the other hand, if the circuit be closed through a brush 22 and its plate 23, and at the same time the circuit is not closed through the corresponding brush and contact plate of the series 24—25, then the main circuit is broken when armature 76 is disengaged from contact 78, since armature 75 was not drawn to contact 77. In this way the operation of the machine will be automatically stopped when different records represented by dissimilarly punched cards, are presented to the two series of record-actuated contacts. As long as correspondingly punched cards, that is, cards having the same index-points in the column 5, are in control the main circuit will be maintained, but when cards belonging to different series are in position to control the main circuit will be opened.

I have not thought it necessary to describe the details of the tabulator or register shown

in Fig. 7 as they constitute no part of my present invention; and likewise I have not deemed it necessary to either show or describe means whereby the particular register shown in this figure may be automatically thrown out of operation at the completion of a cycle of operation, since this idea together with the means for carrying it out is fully disclosed in my before noted Patent No. 1,087,061.

I claim as my invention:

1. In an apparatus of the character described, the combination with record-cards having index-points, of a record-actuated register, and means under the concurrent control of a plurality of such record-cards for maintaining the normal operation of the register and stopping such operation in the event of any difference in the effective control of such record-cards.

2. In an apparatus of the character described, the combination with record-cards having groups of index-points, of a register controlled by one group of index-points, and means concurrently controlled by another group of index-points of a plurality of record-cards for normally maintaining the operation of such register and for automatically discontinuing such operation when such latter index-points do not correspond.

3. In an apparatus of the character described, the combination with record-cards arranged in series and having each, index-points arranged in groups, of a register controlled by the index-points of one group, and means controlled by another group of index-points for rendering the register inoperative after the termination of each series of record-cards, such last mentioned means functioning simultaneously with the control of the register by the index points of the first group.

4. In an apparatus of the character described, the combination with record-cards arranged in series and having each index-points arranged in groups, and means for feeding the record-cards through the apparatus, of a register controlled by the index-points of one group, means controlled by another group of index-points for rendering the register inoperative, and record card controlled means for normally rendering the last mentioned means ineffective during the passage of cards of a common series.

5. In an apparatus of the character described, the combination with record-cards arranged in series and having each index-points arranged in groups, and means for feeding the record-cards through the apparatus, of a register controlled by the index-points of one group, means controlled by another group of index-points for rendering the register inoperative, and means also controlled by the latter group of index-points for normally rendering the last mentioned means ineffective during the passage of cards of a common series.

6. In an apparatus of the character described, the combination with record-cards having index-points, of a record-actuated register, and devices simultaneously controlled by a plurality of record cards for detecting record group changes, including means controlled by the index-point of a card for stopping the register, and means controlled by a corresponding index-point of another card for normally preventing the last mentioned means from being effective.

7. In an apparatus of the character described, the combination with record-cards having index-points, of a record-actuated register, means controlled by corresponding index-points of two cards simultaneously presented to such control means, such means through the index-point of one card serving to throw out the register and through a corresponding index-point of the other card to maintain the register.

8. In a tabulating machine, the combination with record-cards having index-points, of an electric circuit, record-actuated means for opening said circuit, and record-actuated means for preventing said first mentioned means from being effective.

9. In an apparatus of the character described, the combination with record-cards having index-points, of a record-actuated register, an operating circuit therefor, record-actuated means for opening said circuit, and record-actuated means for normally preventing the first mentioned means from being effective.

10. In a tabulating machine, the combination with record-cards, having index-points, of an electric circuit, means controlled by the index-point of a card for opening said circuit, and means controlled by the index-point of another card for preventing said last mentioned means from being effective.

11. In a tabulating machine, the combination with record-cards having index-points, of an electric circuit, record-actuated means for opening said circuit, record-actuated means for preventing said first mentioned means from being effective, and means controlled by said circuit for feeding the record-cards.

12. In an apparatus of the character described, the combination with record-cards having index-points, of a record-actuated register, an operating circuit therefor, record-actuated means for opening said circuit, record-actuated means for preventing said first mentioned means from being effective, and means controlled by said circuit for feeding the record-cards.

13. In an apparatus of the character described, the combination with record-cards, of a record-actuated register, an operating circuit therefor, contacts for opening said

circuit through the instrumentality of one card, and contacts controlled by another card for preventing the first-mentioned contacts from being effective.

14. In an apparatus of the character described, the combination with record-cards having index-points, of a record-actuated register, an operating circuit therefor, record-actuated contacts for opening said circuit through index-points of one card, and record-actuated contacts controlled by corresponding index-points of another card for preventing the first-mentioned contacts from being effective.

15. In a tabulating machine, the combination with a record-card having index-points, of an electric circuit, an electro-magnet in said circuit, means controlled by the index-points for opening said circuit, and means controlled by the same index-points for controlling said magnet to prevent said circuit being opened.

16. In a tabulating machine, the combination with a record-card having index-points, an electric circuit, an electro-magnet in said circuit, two series of contacts controlled by corresponding index-points, one series of contacts effecting the opening of said circuit, and the other series of contacts controlling said magnet to prevent said circuit being opened.

17. In an apparatus of the character described, the combination with record-cards having index-points, of an electric circuit, a record-actuated register in said circuit, record-actuated means for opening said circuit, record actuated means for normally preventing the first-mentioned means from being effective, and means for temporarily maintaining said circuit after it has been opened.

18. In an apparatus of the character described, the combination with record-cards having index-points, of an electric circuit, a record-actuated register in said circuit, record-actuated means for opening said circuit comprising electro-magnets, a branch circuit in which said electro-magnets are located, record-actuated means for normally preventing the first-mentioned means from being effective, and means for temporarily maintaining the main circuit around the record-actuated means by which said circuit is opened.

19. In an apparatus of the character described, the combination with record-cards having index-points, of means for successively feeding said cards, a record-actuated register, an electric circuit including said register and feeding means, record-actuated means for opening said circuit and arresting said feeding means, and record-actuated means for preventing the first mentioned record-actuated means from being effective.

20. In an apparatus of the character described, the combination with record-cards having index-points, of an electric circuit, a record-actuated register in said circuit, record-actuated means for opening said circuit, comprising electro-magnets, record-actuated means for normally preventing the first-mentioned means from being effective, and means for releasing the circuit through said magnets.

21. In an apparatus of the character described, the combination with record-cards having index-points, of an electric circuit, a record-actuated register in said circuit, record-actuated means for opening said circuit comprising electro-magnets, record-actuated means for normally preventing the first-mentioned means from being effective, a branch circuit in which said electro-magnets are located, and means controlling the branch circuit to release the magnet control.

22. In a tabulating machine, tabulating devices controlled by record-cards, devices for feeding the cards thereto, and devices controlled solely by the characteristics of the record cards themselves for detecting record group changes and synchronously interrupting the operation of the feeding mechanism.

23. In a device of the character described, the combination with an accounting machine having designation sensing means, of tabulating means, means for feeding the cards from said sensing means to said tabulating means, means for discharging the cards from said tabulating means, and disconnecting means for stopping the operation of the feeding means from said sensing means.

24. In a device of the character described, the combination with an accounting machine having designation sensing means, of tabulating means, means for feeding the cards from said sensing means to said tabulating means, means for discharging the cards from said tabulating means, and disconnecting means connected to said sensing means to be operated thereby for stopping the operation of the feeding means from said sensing means.

25. In a tabulating machine, tabulating devices controlled by record cards, means for successively feeding the cards thereto, and mechanism automatically controlled through the index points of a record card fed to said tabulating devices for comparing the card in process of tabulation with the next following card and interrupting the operation of the machine when such cards are unlike.

26. In an apparatus of the character described, the combination with record cards arranged in series, means to bring the first card of a series to tabulating position, means directly controlled by the card tabulated for comparing the next following card with the card tabulated, and means for interrupting the operation of the machine when these two cards disagree.

27. In a tabulating machine, tabulating

devices controlled by record cards, feeding means for placing two cards in comparing position, and means for comparing such cards and interrupting the operation of the machine when such cards are unlike.

28. In a tabulating machine, the combination with record cards having groups of index points, feeding means for placing two cards in comparing position, and means for comparing one group of one card with the similar group of another card and interrupting the operation of the machine when such groups are unlike.

29. In combination, a card feeding device for feeding cards successively from a pile, and means cooperating successively with the cards in said pile and controlled by punchings in said cards for causing said card feeding device to intermit its feeding action when a card having different controlling punchings from the preceding card is reached.

30. In combination, discharge mechanism, a card supplying device for feeding cards to said discharge mechanism, and means cooperating successively with the cards supplied from said card supplying device to said discharge mechanism and controlled by punchings in said cards for intermitting the supply of cards from said card supplying device to said discharge mechanism when a card is reached having different controlling punchings from those in the preceding card.

31. In a machine of the class described the combination of perforated-card-controlled mechanism and a finder comprising a group of members which take advanced or retracted positions according as corresponding spaces on the card are perforated or imperforate, and means for causing a regular operation of the machine only when said members take the same position under control of a card which they took under control of the previous card.

32. In a machine of the class described the combination of perforated-card-controlled mechanism, means for feeding cards in succession to operative position and a finder adapted to cause a stoppage of the feed when a card perforated according to a new class arrives at the operative position.

33. In a machine of the class described the combination of perforated-card-controlled mechanism, means for feeding cards in succession to operative position and a finder adapted to cause a stoppage of the machine when a card perforated according to a new class arrives.

34. In a machine of the class described the combination of perforated-card-controlled mechanism, means for feeding cards in succession to operative position and a finder adapted to cause a stoppage of the feed when a card perforated according to a new class arrives at the operative position, said finder adapted to automatically assume a plurality of operative positions corresponding to a plurality of classes.

35. In a machine of the class described the combination of perforated-card-controlled mechanism, means for feeding cards in succession to operative position and a finder adapted to cause a stoppage of the machine when a card perforated according to a new class arrives, said finder adapted to automatically assume a plurality of operative positions corresponding to a plurality of classes.

36. In combination, discharge mechanism, a control member, a feeding device for feeding cards to and from the control member and to the discharge mechanism, and means controlled by each card fed to the control member for selectively determining whether the feeding device shall at once feed said card from the control member to the discharge mechanism or not.

37. In combination, a control member, a feeding device for feeding cards to and from such control member, and means controlled by each card fed to the control member for determining whether such card shall be fed from the control member immediately or subsequently.

38. In combination, a discharge mechanism, a control member, a feeding device for feeding cards from the control member to the discharge mechanism, and means cooperating with each card supplied to the control member for determining whether such card shall be fed to the discharge mechanism immediately or subsequently.

39. In combination, a card-feeding device for feeding cards successively from a pile, and means cooperating successively with the cards from said pile for selectively determining whether said card feeding device shall continue or intermit its feeding action of cards from such pile.

40. In combination, a discharge mechanism, a card-supplying device for supplying cards to said discharge mechanism, a feeding device for feeding cards successively from said card-supplying device to said discharge mechanism, and means cooperating with the successive cards from said card-supplying device for controlling said feeding device.

41. In combination, a control member, a feeding device for feeding cards successively from a pile to the control member and then off the control member, and means controlled by the action of the cards which pass on to the control member for selectively determining whether the feeding device shall continue or intermit its aforesaid feeding action.

42. In combination, discharge mechanism, a card-supplying device, a feeding device for feeding cards from said card-supplying device to said discharge mechanism, and means cooperating successively with the cards from said card-supplying device for causing an in-

termitting of the action of the feeding device on the cards from said card-supplying device when a card is reached which differs in any controlling respect from the preceding card.

43. In an apparatus of the character described, the combination of an analyzer; a feeding means therefor; an actuator therefor; and means operated by the analyzer for causing the actuating means to lock the feeding means.

44. In an apparatus of the character described, the combination of an analyzer; an analyzer feeding means; an analyzer actuating means; means for locking said feeding means; a sensing means operated by said analyzer; and means operated by the sensing means for causing said locking means to engage the actuating means for bringing about the locking of the feeding means.

45. In an apparatus of the character described, the combination of an analyzer; feeding means for feeding cards to the analyzer; and a locking means for locking the feeding means.

46. In an apparatus of the character described, the combination of an analyzer; feeding means for feeding control-means to the analyzer; and a locking means adapted to be actuated by said analyzer for locking the feeding means.

47. In a machine of the class described, means for feeding records, means for sensing data on such records, and means controlled by said sensing means for controlling said feeding means.

48. In a machine of the class described, means for feeding records, means for sensing data on said records, said means including designation sensing elements, and means controlled by said elements for interrupting the normal operation of the machine when a record having a different designation is sensed by said elements.

49. In a machine of the class described, means for feeding perforated records, means for sensing designation numbers in the form of perforations in successively presented records, and means controlled by said sensing means for interrupting the normal operation of said feeding means when a record having a different designation number from a previous record is sensed.

50. In a machine of the class described, means for sensing data on successively presented records, said means including designation sensing elements and means controlled by said elements for interrupting the normal operation of the machine when a record having a different designation is sensed by said elements.

51. An automatic control system for a record controlled machine comprising analyzing mechanism for searching index point designations on controlling records while the latter are in motion and means controlled by said mechanism for controlling the machine operation in accordance with like and unlike designations on successive records.

In testimony whereof, I have signed this specification.

HERMAN HOLLERITH.

Jan. 19, 1926. 1,570,264

C. D. LAKE

AUTOMATICALLY CONTROLLED TABULATING MACHINE

Filed Dec. 30, 1921 2 Sheets-Sheet 1

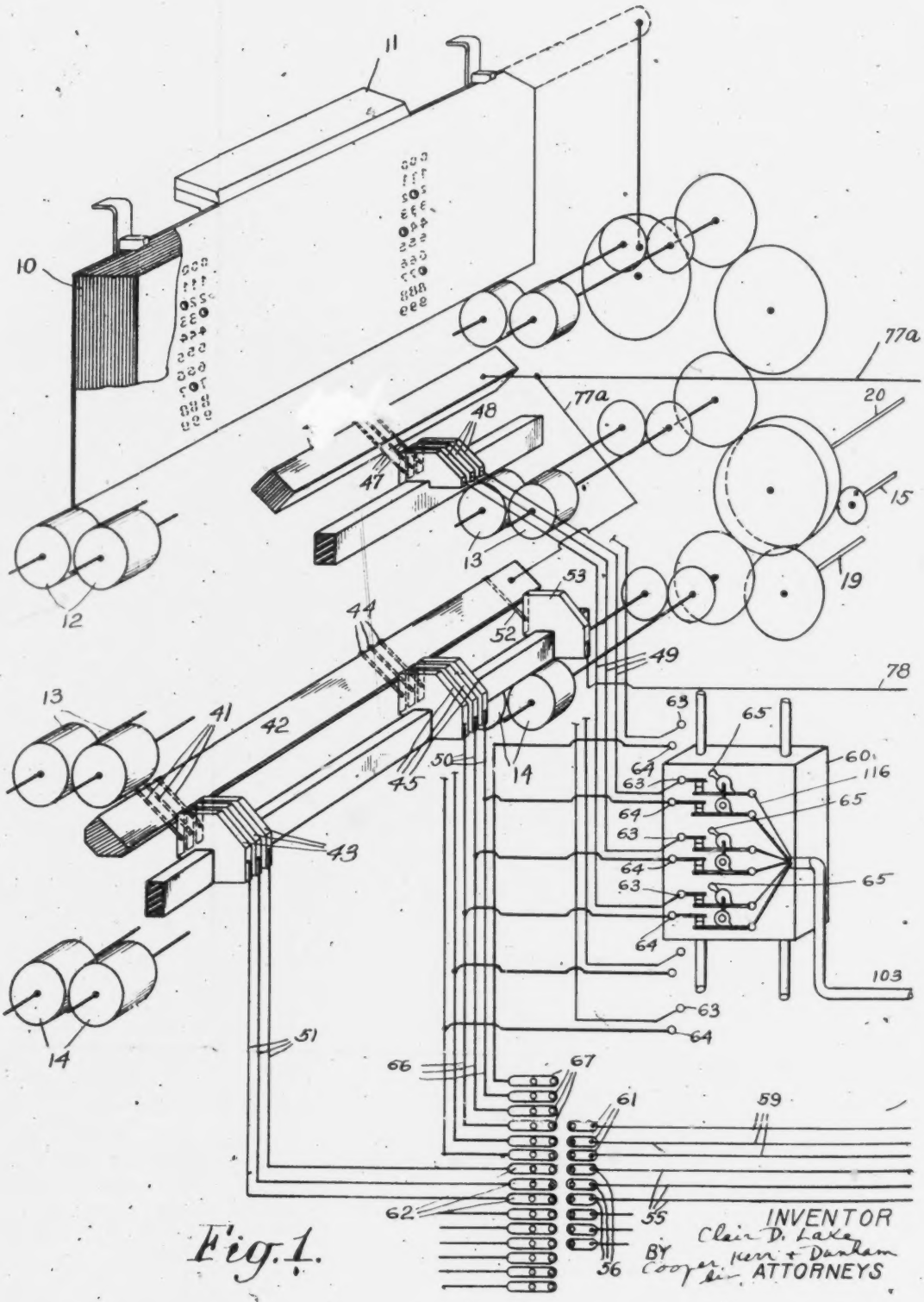

Fig. 1.

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AUTOMATICALLY CONTROLLED TABULATING MACHINE

Filed Dec. 30, 1921 2 Sheets-Sheet 2

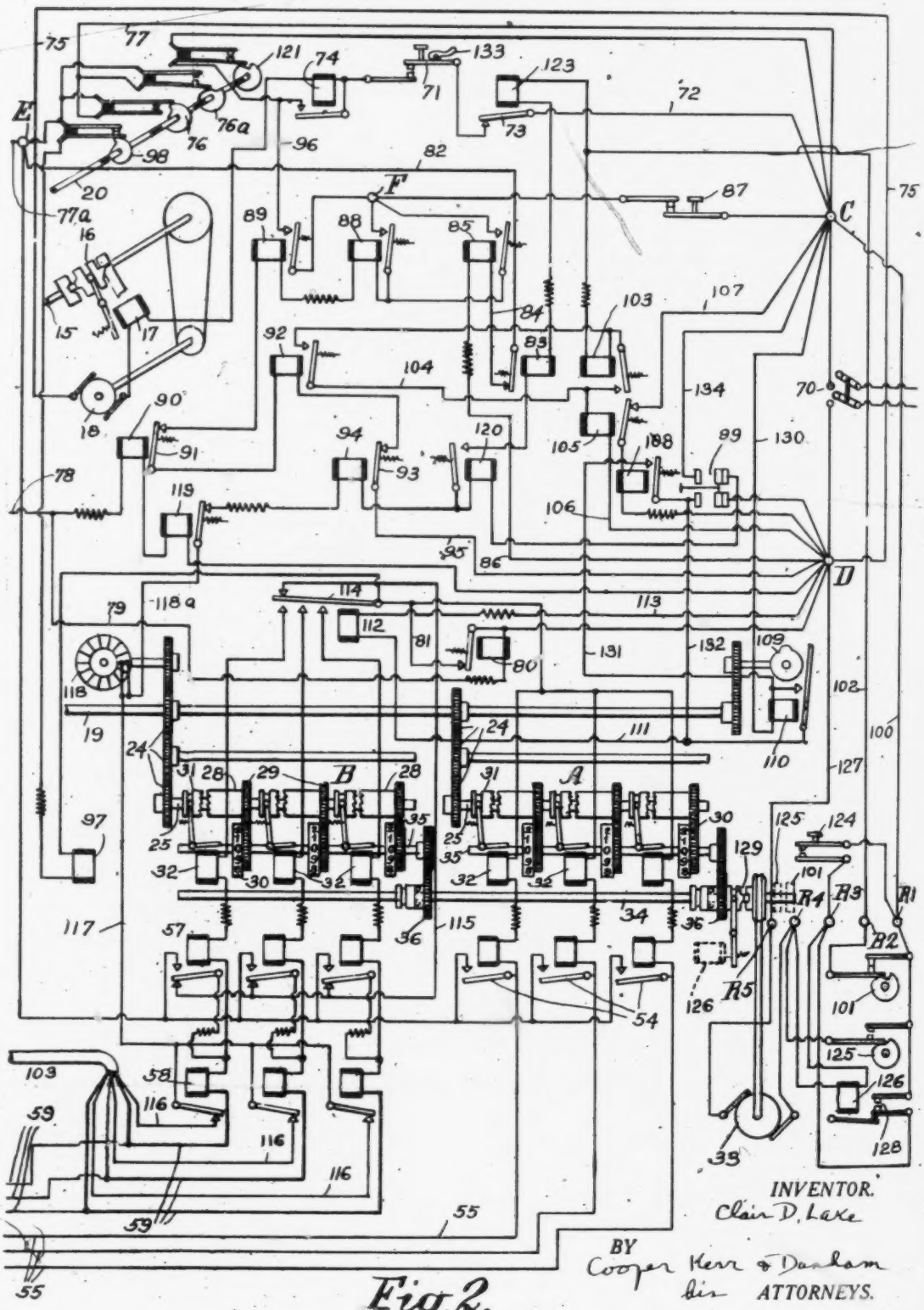

Fig. 2.

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UNITED STATES PATENT OFFICE.

CLAIR DENNISON LAKE, OF BINGHAMTON, NEW YORK, ASSIGNOR TO THE TABULATING MACHINE COMPANY, OF ENDICOTT, NEW YORK, A CORPORATION OF NEW JERSEY.

AUTOMATICALLY-CONTROLLED TABULATING MACHINE.

Application filed December 30, 1921. Serial No. 525,864.

To all whom it may concern:

Be it known that I, CLAIR D. LAKE, a citizen of the United States of America, residing at Binghamton, in the county of Broome and State of New York, have invented certain new and useful Improvements in Automatically-Controlled Tabulating Machines, of which the following is a full, clear, and exact description.

This invention relates to tabulating machines. More specifically it relates to tabulating machines which may be employed to perform various functions, as will hereinafter appear.

Tabulating machines have been heretofore proposed in which a stop card or stop cards are relied upon automatically to stop the machine, or otherwise modify its operation. At the end of each series of cards of a particular group a stop card was placed. The machines toward which the present invention is directed relate to a class in which control is secured directly from index points of the record cards themselves, such control being effected through automatic control devices. These automatic control devices are automatically called into action by change in such index points, which represent group designations or like data, and so govern the operation of the machine as to permit a reading to be taken preparatory to tabulating the succeeding card group.

One of the principal objects of the present invention is to effect improvements in such automatic control devices and the tabulating machines of which they form a part, to the end that they may be made more flexible and adaptable to the varying demands of the art to which they relate.

Referring to the drawings, which illustrate somewhat diagrammatically what I now consider to be a preferred physical embodiment of the invention,

Fig. 1 is a diagrammatic illustration of certain of the working parts of a tabulating machine and circuit connections therefor, and

Fig. 2 is a diagrammatic view of the remainder of the machine, the circuit connections and certain mechanical connections of this figure being so illustrated as to join corresponding circuit connections and mechanical connections in Fig. 1, when the two figures are placed side by side.

In the tabulating machine shown, 10 designates a stack of record cards which are fed one by one by means of a picker 11 to suitable upper feed rolls 12 whence the cards are successively advanced through intermediate and lower rolls 13 and 14, to the discharge stack, not shown. The rolls and picker are all driven in unison by the gearing shown diagrammatically in Fig. 1. The drive to this gearing is secured through a shaft 15 which extends to the main tabulator clutch 16 (Fig. 2). This clutch is magnetically controlled by magnet 17, which when energized couples the card feed devices with the tabulator motor 18. Rotating in unison with the card feed devices is a main tabulator register shaft 19. This shaft is driven in any suitable manner from the gearing which rotates the feed rolls. Also geared to the feed is a contact cam shaft 20.

From the register shaft 19, gearing 24 drives the clutch shafts 25, there being an independent clutch shaft for each register.

The registers are of the well known Hollerith type, and inasmuch as each register includes a number of wheels and controlling magnets which are identical, only one section need be described. Upon the clutch shaft 25 are clutch disks 28 having fixed thereto gears 29 which enmesh with gears fixed to each counter wheel 30. In order to rotate the counter wheels, clutches 31 are provided which are mounted to rotate in unison with the clutch shaft and are slidable thereon into engagement with the clutch disks 28. Engagement of the clutches is effected by the energization of counter magnets 32 the armatures of which engage clutch elements 31.

The energization of the counter magnets is controlled by the index-point perforations of the record cards in a manner now well known to those skilled in the art. (See for example Hollerith United States Patent No. 945,236.)

In the diagram no disclosure has been made of transfer devices, since these are of the type well known in the art, and their illustration would involve mere surplusage. Such transfer devices may be of the type disclosed in the United States patent to Hollerith, No. 974,272.

Resetting of the counter wheels is effected

by means of a reset motor 33. This motor, through suitable gearing and magnetically controlled clutch 129, drives a reset shaft 34 which extends across the counters and drives the counter wheel shafts 35 to reset the same by means of individual gear sets 36 which are selectively clutched with the reset shaft 34. These features are common and well known in tabulating machines and require no detailed description.

In order to simplify illustration it may be stated that the drawings show one accumulating register or counter A, with wheel sections, and one register B which may be used for group indicating or accumulating operations. In practise both of these registers will have more sections, and a plurality of accumulating registers will be provided. The magnets 32 of register A are provided with the usual Hollerith relays 54, and from these relays wires 55 lead to plug points 56. The group-designation or indicator register B is provided with double point relays 57, and single point relays 58. The wires 59 which lead to the magnets 58 are branched as follows: one branch extending as shown in heavy lines through the flexible cable to a slide block 60; the other branch extending to the plug point 61, shown in Fig. 1.

Referring now to Fig. 1 of the drawings: the successive perforated record cards pass first between the upper and then through the lower sets of brushes. There are two sets of lower brushes 41—44, carried by common bar 42, and cooperating with contact blocks 43—45. The upper brushes 47 are carried by common bar 46, and cooperate with contact blocks 48. It will be understood that the circuit from the brushes to the contact blocks is established when the index point perforations of the record cards pass under the brushes. The upper and lower brush sets 47—44 are for comparing group numbers or designations, and the lower set 41 are for the item numbers alone. In practise there are more than the three brushes shown in these various sets. From contact blocks 43 wires 51 extend to plug points 62. These item plugs are usually connected by plug connections to the points 56 to control the operations of the accumulating counter A. It will be understood that there are more than three plug point positions 62—56, and these extra plugs will be used depending upon the number of columns in the card, and magnets in the counter or counters.

From the upper contact blocks 48, wires 49 extend to contact points 63. From the lower contact blocks 45, wires 50 extend to corresponding contact points 64. There is one point 63 for each upper brush position and a point 64 for each corresponding lower brush position. The slide member 60 is provided with cooperating contact points which make contact with points 63—64 so as to permit a selected group of upper and lower brushes to be connected with the group-designations or indicator register B. In the diagram, block 60 is shown provided with three pairs of connections so that connection can be established with any three pairs of contact points 63—64. In practise any desired number of these points can be provided, depending upon the number of sections in the B register. The contact block 60 is also provided with individual switches 65 which, upon manipulation, are adapted to either selectively make or break the circuits to the upper and lower brush leads 49—50 respectively. As shown, the single switch simultaneously makes or breaks these circuits in pairs.

The leads 50 which extend to the lower brush contact blocks 45 are also provided with extension leads 66 which extend to plug sockets 67. The purpose of these leads may be thus explained: the selected plugs 67 are coupled by plug connections to 56 permitting the group numbers which are being indicated on counter B to be accumulated on counter A or any other counter which may be provided but not here shown. These extension leads 66 provide particular utility also when only certain of the lower brushes connected to leads 50 are being used for group indicating. Those not used and not connected by slide block 60 to group indicating register B may be connected up for accumulating on the A or similar register by means of the aforesaid plug connections. The operation may be best understood by considering no cards under the brushes, and the tabulator stationary.

Switch 70 leading to the source of current supply is first closed thereby establishing the group indicator control circuit traced as follows: From binder post C through wire 107, armature of relay 105, relay 108, and back to binder post D. By the energization of relay 108 the following group indicator circuit is immediately completed traced as follows: From binder post C through wire 130, relay 110, wire 131 to armature of relay 108, thence through wire 132, 111, relay 112, and through wire 113 to binder post D. The energization of relay 110 is now maintained by two circuits: first through the armature of relay 108 just described, and second through its own armature, wire 111, relay 112, wire 113 to binder post D.

Group indicator counter control relay 112, now being energized, has attracted its armature 114 thereby making contact with individual wires leading to magnets 32 of counter B. This armature 114 maintains this connection with counter B until after passage of first card of a group of cards.

The operator then depresses start key 71.

Current now flows from source through binder post C, wire 72, relay armature 73, start key contacts 71, now closed, motor relay 74, clutch magnet 17, tabulating motor 18, and back through wire 75 to binder post D, to source. It is necessary to hold the start key depressed until the record cards 10 feed into the machine and pass under supplementary brush 52 (Fig. 1), interrupting the circuit between the brush 52 and contact block 53. The initial rotation of the motor has rotated contact cam shaft 20, and allowed cam contact 76 to close a circuit permitting current to flow through line 77, cam contacts 76, to binder post E. From this post E, wire 77ª leads to the upper and lower common brush bars 46—42. Until cards get under the lower brushes it is necessary to prevent the energization of the counter magnets and relays controlled by the brushes. This control is secured by means of the supplementary brush 52 which until cards pass under it allows current to flow from line 77ª through wires 78—79, counter control relay 80, and back to binder post D. The energization of the relay 80 breaks the return circuit 81 of the various counter magnets and prevents the effective operation of the counters until relay 80 becomes de-energized by a card passing under brush 52. The counter control relay 80 remains de-energized until the last card has passed out of the machine. The operator holds down start key 71 until a card is fed from the stack 10 down under the lower supplementary controlling brush 52. This requires a few card cycles. At the beginning of the card cycle, cam contact device 76 will remake. At this time current flows from binder post C through wire 77, cam contact device 76, binder post E, wire 82, armature of circuit cut out relay 83, wire 84, relay 85, wire 86, and back to source through binder post D. The energization of relay 85 closes a circuit as follows: from source binder post C, emergency stop key 87, binder post F, armature of relay 85 through motor control relays 88—89, armature 91 of last card control relay 90, department or group indicator cutout circuit control relay 92, armature 93 of automatic stop control relay 94, and back through line 95 to binder post D. The armature of relay 85 will release once per card, but the armature of relay 88 will have closed a holding circuit through 88—89 etc. This holding circuit will be held until a change in card group occurs when it will be interrupted in a manner to be hereinafter described. The energization of relay 89 establishes a holding circuit for the motor relay 74 through wire 96. This last mentioned circuit maintains the motor in operation after the start key 71 is released.

As previously explained, when cards are passing, relay 80 is deenergized allowing the return circuit from counter A to be established through line 81. Counter A now accumulates items in the usual manner of the Hollerith counter. Similarly magnet 80 when deenergized allows current to flow through card counter magnet 97 which counts up cards in the usual manner. This card counter is controlled by cam contact assembly 98 on shaft 20. Its registering counter is not herein shown as it is of the usual Hollerith type.

As is well known in these machines, the group indicator counter is adapted to set up on the counter wheels the group number of the first passing card and thereafter cut out the operation of the counter for the succeeding cards of the group. For further description of this group indicator as previously used reference may be had to Hollerith Patent No. 1,087,061, dated February 10, 1914.

When utilizing counter B as a group or departmental counter, cut out switch 99 is first thrown to the right in the position shown. Relay magnet 92 having been previously energized, a circuit is established as follows: from binder post C, through wire 100, cam contact device 101 now closed, wire 102, relay 103, through armature of relay 92, wire 104, relay 105, and back through wire 106 to binder post D. This completes the department indicator cut-out circuit. The energization of relay 103 attracts its armature and establishes a holding circuit, which is maintained even if relay 92 is deenergized. The energization of relay 105 breaks the department indicator control circuit which was previously made as soon as switch 70 was closed irrespective of cards entering into the machine. Upon the breaking of this department indicator control circuit, armature of relay 108 is retracted, thereby breaking the first holding circuit through lead wire 132 to relays 110—112 which were energized as previously explained. The second remaining holding circuit to relays 110—112 must now be broken. This is accomplished by a cam device 109 which is geared with the proper gearing to shaft 19 to make one revolution for each card passing the brush. After the first card has been set up on counter B this cam device knocks off the armature of relay 110, and breaks the second or last holding circuit of the department indicator circuit. When this relay 112 is deenergized, by knocking off of the armature of relay 110 by cam 109, the armature 114 will be drawn upwardly, thereby breaking the individual circuits of the magnets 32, and preventing back circuits as succeeding cards pass through the machine. When armature 114 is in the upper position it establishes counter cut-out circuit 115 to the lower armature

points of counter brush relays 57. The purpose of this circuit is to provide a path for current to flow when succeeding cards after the first card are passing through the tabulator. This is necessary since these succeeding cards are used for automatic controlling.

It will be noted that in counter B, in addition to the relays 57, there are automatic control relays 58 in circuit with the individual magnets 32. The magnet circuit of these relays 58 connects to lines 59 which, as previously explained, extend into the sliding member 60. Wires 59 are here shown with heavy lines. These extend through flexible cable and sliding block 60 and eventually to leads 50 and to the lower brushes. The armature points of relays 58 on the other hand connect to circuit leads 116 which also extend through the sliding block 60 as shown by the light lines therein, and eventually connect through leads 49 with the upper brushes. The establishment of the circuit from the upper brush, which circuit is known as the upper card control circuit, after passing through armature of relays 58, flows through a common line 117 to one brush cooperating with commutator 118. This commutator is geared with the proper gearing with shaft 19 to make one revolution for each card passing the brush. It is provided with a plurality of conducting segments insulated from each other, each segment corresponding to one index point perforation on the card, and the segments are of such width, and brushes so adjusted that the time of the establishment of the circuit 117 by commutator is less than the time of establishment of the circuit through upper brush 47 by the perforation or perforations in the record card. The circuit 117 from the commutator extends through a lead 118ª to the armature of upper card circuit cut-out relay 119, thence through automatic stop control relay 94 through upper card circuit control relay 120, through department indicator cut-out switch 99 to binder post D. It may be here stated that as long as current does not flow through the circuit 117–118ª, armature of relay 119 etc., the machine will continue to run, but when current flows in this circuit the operation of the tabulator will be interrupted, as will be later explained.

Assume that two cards are passing through the machine, one under the upper brush, and the other under the lower brush, and that these cards have corresponding index points, for example #9. The lower brush will establish a circuit through leads 59 energizing relay 58. Although a contact is simultaneously made through the card under the upper brush this contact will not complete a circuit since as previously explained it is not permitted to be established until slightly later in the card cycle, by reason of the commutator 118. Therefore, by the time this circuit could be finally completed through the brushes and segment of the commutator, the relay 58 will have attracted its armature and prevented the closing of this circuit. Under these conditions the machine will continue to run since the cards are alike in their controlling perforations. It may be explained that this comparison of cards is effected by each two successive cards passing through the machine.

Assume now that cards under the upper and lower brush have unlike perforations, say 8 and 9, the lower brush will make circuit 59 and energize relay 58. However, at this time the circuit from the upper brush to lead 116 is incomplete since there is no perforation under the brush. The machine will continue to run since as previously explained this operation continues as long as current does not flow in the 117 circuit. However, when the 8 point goes under the upper brush there will be no current flowing through lower brush, consequently relay 58 is not energized, and a circuit is established through wire 117 which controls the stopping of the machine.

The foregoing has explained the manner of control on one column, but it will be understood that the control can be effected upon a plurality of columns and a change of index point positions in any one of these columns will effect a stopping of the machine. The flow of current through 117—118ª to control the stoppage of the machine is only of short duration. This flow of current actuates a number of relays as will now be explained:

First relay 94 attracts armature 93, thereby deenergizing relays 92—89—88. The deenergization of 89—88 releases the armatures which control the motor circuit through lead 96. The machine does not immediately stop upon the deenergization of 89—88, the motor circuit is maintained through wire 122, cam contacts 121, relay 74 until slightly before the so-called D position is reached, at which time contact device 121 breaks, thereby deenergizing relay 74, the main clutch magnet 17, and cutting off flow of current to motor 18, thus stopping the machine at the so-called D position.

The flow of current through 117—118ª also energizes relay 120, attracting the armature thereof which establishes a holding circuit through relay 83, relay 123, and back to wire 102, cam contact device 101, wire 100 to binder post C. The energization of relay 83 attracts its armature interrupting circuit 84 to relay 85. The armature of this relay is then retracted thereby preventing the reestablishment of the circuits to motor control relays 88—89 after the index point has passed beyond the upper card brushes. Re-

lay magnet 123 when energized attracts its armature 73, thereby interrupting the circuit 72 to the start key 71. This prevents the restarting of the tabulator until the reading is taken and the machine reset to 0, or the reset motor cycle completed. It may be here explained that it is not necessary to actually reset counters to 0, but it is necessary that reset should be initiated, and completed before the tabulating can be restarted.

The foregoing operation has automatically interrupted the tabulating operation, brought the machine to a stop, and prevented the starting until certain further operations are performed. A reading is now taken of the counters of the tabulator. Such counters as are to be reset are coupled up to the resetting shaft 34 by means of the gears 36, and associated clutch device. The cam contact devices 101—125 are mounted upon the end of the reset shaft 34, and these cam contact devices are actuated once for each reset cycle. A depression of reset key 124 will allow current to flow from source through binder post C, line 100, binder post R^1, reset key 124, binder post R^2, reset magnet 126, binder post R^4, through reset motor 33, binder post R^5, back through wire 127 to binder post D, and the current source. After depressing the reset key 124 it is possible to immediately release same since the energization of magnet 126 closes contacts 128, and allows current to continue to flow from binder post R^1, through contacts 128, R^3, back to 126, etc. At a slightly later point in the resetting cycle this circuit is taken over by cam contact device 125 which short circuits the magnet 126, and interrupts the reset motor circuit at the end of the reset cycle. The magnetically controlled clutch 129, which is of the usual one revolution type, insures the shaft 34 making exactly one revolution in resetting. The cam contact device 101 is so timed as to temporarily open just before the end of the reset cycle. These contacts are thereafter immediately remade, and remain so at the completion of the reset cycle. The opening of these contacts serve to control a number of circuits as will now be explained.

The opening of cam contact device 101 serves to interrupt circuit 102 which as previously explained extends to relays 123—83—94. The opening of this circuit deenergizes these relays allowing their armatures to fall back to position shown and permitting the restart of tabulating by depression of the start key in the manner heretofore explained. The deenergization of relay 83 allows its armature to drop back and permit the establishment of the circuits which control relays 88—89 so that these latter relays can again be effective. The deenergization of circuit 102 by cam contacts 101 has the further function of deenergizing the holding relay 103, and relay 105 controlled thereby. The deenergization of relay 105 allows the armature to retract thereby establishing the department indicator control circuit, which in turn establishes the department indicator circuit as previously described and relay 112 again connects department indicator counter B for registering the first car of a new group.

Cam contact 76^a operates in conjunction with cam contact device 76 to control circuits 77^a to the brushes. These cam devices are common, and well known in tabulating machines of this type, and interrupt the circuit to these brushes at the completion of each adding cycle.

Relay 90 has been previously mentioned, but it has a further function in connection with control when the last card passes out of the tabulator. When the last card has passed the lower brushes, supplementary brush 52 will establish contact with contact block 53, allowing current to flow through line 78 to relay 90, and back through relay 119 to binder post D. The energization of relay 90 attracts armature 91, and interrupts the flow of current through the control relays 88—89, thereby bringing the machine to a stop, in the manner heretofore explained. This last card control is not necessary when the machine is used in connection with the automatic control device previously described. When these automatic control devices are cut out of action, this last card control is necessary to interrupt the tabulating operation upon the passage of the last card from the machine.

The emergency stop key 87 is in the return circuit from the main controlling relays 88—89. The depression of the stop key 87 at any time will bring the tabulator to a stop at the end of the card cycle at the well known D position. After this stop key is operated the restart of the tabulator can be secured by depressing start key 71 provided the tabulator is not at the end of a card group where a total reading should be taken. Under these latter conditions the start key circuit will be interrupted by means of the armature 73 of relay 123 as previously described. It will now be necessary to take a reading and effect a resetting before the tabulator can be restarted upon the next card group.

When it is desired so to employ the machine that the tabulator will automatically restart upon the completion of the resetting operation, the start key will have been closed and held closed by throwing over a small eccentric lever or like device, 133. When this lever is thus thrown the tabulator will automatically restart upon the completion of the resetting cycle without any manual initiation whatever on the part of the operator.

It may be here explained that the restart-

ing of the tabulator prematurely is prevented by reason of the relay 123 which does not become deenergized until the completion of the reset operation under the control of cam contact device 101 as previously explained.

Under certain conditions it may be desirable to utilize the machine as a straight tabulator, and suppress the automatic control and group indicating operation. This is effected by throwing department indicator cut-out switch 99 to the left hand position. When switch 99 is thrown to left hand position a circuit is established from binder post C, through wire 134, switch 99, wire 132, wire 111, relay 112, and back through wire 113 to binder post D. This maintains relay 112 energized at all times and permits the accumulating of items on counter B. When switch 99 is thrown to the left the upper card control circuit through relays 94—120 etc. is interrupted so that irrespective of the closure of the control circuit at the upper brush there will be no automatic control of the tabulator.

In view of the foregoing disclosure it will be seen that I have provided a tabulating machine in which the automatic control devices so govern the operation of the machine as to permit the total or accumulation of a card group, or other tabulated card data, to be taken at the end of a card group. In the specific form of invention disclosed, the automatic control devices exercise their governing function by interrupting the tabulating operation. The machine comprises also means for resetting the tabulator wheels and for subsequently initiating, either manually or automatically, at will, restarting of the tabulating operation upon the succeeding card group. Provisions are included whereby group numbers are designated so that the operator is apprised of the particular card group, or groups, upon which the automatic control devices are operating, or have operated. Of the two counters or registers illustrated, one may be used for group-designating and controlling, and the other for item-accumulation; or both counters may be employed for accumulating; or one counter may be employed for group-designating and the other for accumulating the group numbers designated by the first. It will be noted further that the automatic control may be effected from different groups, selectable at will, of a number of columns of index points of the cards, and that, in addition, one or more columns of any selected group may be suppressed at will.

Other advantages will now be apparent in view of the disclosure and need not be enumerated.

What I claim is—

1. In an apparatus of the class described, in combination, tabulating devices controlled by index-points of record cards, means jointly controlled by index points of a plurality of cards passing through the machine for governing operation of the machine, and means whereby the index point columns to effect such control may be selected at will from a plurality of index point columns.

2. In an apparatus of the class described, the combination of record cards having index-points, of a record-actuated register, index-point controlled means called into action when record groups change for stopping the registering operations, means for resetting the register, and means for automatically initiating restarting of the registering operation upon a new record card group after the register has been reset.

3. In an apparatus of the class described, the combination of record cards having index-points, of a record-actuated register, index-point controlled means called into action when record groups change for stopping the registering operations, and means for initiating resetting of the register and thereafter initiating restarting of the same in its registering operation upon the succeeding card group.

4. In an apparatus of the class described, the combination of record cards having index-points, of a record-actuated register, index-point-controlled means called into action when record groups change for stopping the registering operation, means for resetting the register, and manual means for restarting registering operation upon a new record card group.

5. In an apparatus of the class described, the combination of record cards having index-points, of a record-actuated register, index-point-controlled means called into action when record groups change for stopping the registering operation, means for resetting the register, manual means for restarting registering operations upon a new record card group and means for rendering said manual means ineffective to restart registering operation before the preceding resetting operation is completed.

6. In an apparatus of the class described, the combination of record cards having index-points, of a record-actuated register, index-point-controlled means called into action when record groups change for stopping the registering operation, means for resetting the register, means for automatically initiating restarting of the registering operation upon a new record card group after the register has been reset, means for rendering said automatic means inoperative, and manual means for restarting registering operation upon a new record card group.

7. A tabulating machine comprising in combination; card-controlled registering mechanism; means for stopping said machine at any time; means for restarting said

machine; and means for preventing such restarting when the machine has been stopped at the end of a card group, until the registering mechanism has been placed in condition for a new card group.

8. A tabulating machine comprising in combination, card-controlled registering mechanism, card controlled means called into action when card groups change for stopping the registering operation, means for placing the registering mechanism in condition for a new card group; means for stopping said machine at any time, means for subsequently restarting the machine; and means for preventing such restarting when the machine has been stopped at the end of a card group, until the registering mechanism has been placed in condition for a new card group.

9. A tabulating machine comprising in combination; means for feeding record cards through said machine; card-controlled, group-designating tabulating devices; card-controlled, item-accumulating devices; and means automatically called into action upon a group change in the cards for governing the operation of the machine.

10. A tabulating machine comprising in combination; means for feeding record cards through said machine; card-controlled, group-designating tabulating devices; card-controlled, item accumulating devices; and means automatically called into action upon a group change in the cards for placing said accumulating devices in total-taking condition.

11. In a machine of the class described, in combination; means for feeding record cards having index points, through the machine; registering mechanism; card-controlled means and connections whereby said registering mechanism may be employed for group-designation or item-accumulation at will; and means, operable when said machine is employed for group-designation and automatically called into action upon a group change in the index points of said record cards, for governing the operation of said machine.

12. A tabulating machine of the class described comprising in combination; means for feeding record cards, having index-points, through the machine; card-controlled, group-designating devices; means automatically called into action upon a group change in the index points of said record cards for interrupting the tabulating operation; and means for subsequently resetting said group-designating devices to place them in condition for a new card group.

13. In a machine of the class described, in combination, tabulating devices controlled by index points of record cards, means controlled by selected index points of cards passing through the machine for governing operation of the machine upon change of record groups, means whereby various groups of columns of index points to effect such control may be selected at will from a plurality of index point columns, and means for selectively suppressing one or more columns of any selected group of columns.

14. A tabulating machine comprising in combination; means for feeding record cards through said machine; card-controlled, group-number-designating tabulating devices; means automatically called into action upon a group change in the cards for governing the operation of the machine; and means for accumulating the total of a series of group designations.

15. A machine of the class described, comprising in combination, record cards having columns of index points, means for feeding such cards through the machine, means controlled by selected index points of cards passing through the machine for governing operation of the machine upon change of record groups, means whereby one or more columns of index points to effect such control may be selected at will from a plurality of index point columns, and item accumulating devices controlled by certain columns of the record card index points.

16. A machine as set forth in claim 15 in which the control on record-group-change is effected from one or more of a plurality of columns of record and index points and in which the item-accumulation is effected from one or more of the remaining columns of record card index points.

17. A machine as set forth in claim 15 in which the control on record-group-change is effected from one or more of a plurality of columns of record and index points and in which the item-accumulation is effected from one or more of the remaining columns of record card index points which are not available for effecting control on record group changes.

18. A machine as set forth in claim 15 in which any of a group of columns of record card index points are available for effecting control upon record group changes, and in which the item-accumulating devices may be caused to accumulate items of any of the said group of columns which are not being employed for effecting control upon record group change.

19. A tabulating machine comprising in combination, record cards having columns of index points, means for feeding such cards through the machine, a group-designating register and means for controlling the same, automatic controlling devices for said machine, means whereby said register and devices may be controlled from any of a predetermined number of the columns of record card index points, and means where-

by said register may be employed to accumulate items from any or all of the columns of the record card index points.

20. A tabulating machine comprising in combination, a card-actuated electric contact couple, a circuit controlling device and means for actuating the same whereby the time of contact of said device is less than that of said couple, and a controlling circuit connecting said couple and device in series.

21. In an apparatus of the class described, the combination of record cards having index points, of a record actuated register, index point controlled means called into action when record groups change for stopping the registering operations, means for selectively coupling said last mentioned means with various groups of columns of index points, said columns being selectable at will from a plurality of index point columns on the cards, means for resetting the register, and means for automatically initiating restarting of the registering operation upon a new record card group after the register has been reset.

22. A tabulating machine comprising in combination, means for feeding record cards through the machine, card-controlled group designating devices having provisions for accumulating items when desired, card-controlled item accumulating devices, and means automatically called into action upon a group change in the cards for governing the operation of the machine.

23. A tabulating machine comprising in combination, means for feeding record cards through the machine, card-controlled group designating devices with provisions for accumulating items from the cards when desired, and means automatically called into action upon a group change in the cards for placing the accumulating devices in reading condition so that the amounts thereon may be read therefrom.

24. A tabulating machine including in combination, means for feeding cards through the machine, means for registering items from cards, index point controlled means called into action upon change in the designating group numbers of said index points for interrupting the operation of the machine and means for selectively coupling said last mentioned means for control by any selected group of various groups of one or more columns of index points.

25. In a card-controlled machine of the class described, in combination, a tabulating machine to accumulate items from record cards, an automatic control device having provisions for comparing two record cards and interrupting the operation of said machine when said cards are unlike, and selective means for rendering said automatic control device effective or ineffective.

26. In a card-controlled machine of the class described, in combination, a tabulating machine to accumulate items from record cards, an automatic control device for interrupting the operation of said machine when card groups change, and selecting means for rendering said automatic control device effective or ineffective.

27. The invention set forth in claim 26 in which the selecting means for the automatic control device comprises an electric switch which is adjustable for rendering the machine subject to automatic control or not subject to such control.

28. In a card-controlled machine of the class described, in combination, a tabulating machine for accumulating items from cards fed therethrough, automatic control devices for interrupting the tabulating operation when a card of a group differing from the card or cards of the preceding group passes through said machine, and selective means for suppressing or permitting the operation of said control device.

29. In a tabulating machine, in combination, one or more card-controlled registers each adapted to receive items from index points on record cards having a plurality of columns, an automatic control device for changing the operation of said tabulating machine when record card groups change, and means for selectively coupling said automatic control device for control by the index points of any one of a plurality of said card columns for the purpose described.

30. In a tabulating machine, in combination, one or more card-controlled registers each adapted to receive items from index points on record cards having a plurality of columns, an automatic control device for changing the operation of said tabulating machine when record card groups change, and means for selectively coupling said automatic control device for control by the index points of a number of columns which may be selected from various combinations of a plurality of index point columns.

31. In a tabulating machine, in combination, a plurality of registering devices adapted to receive items from various index points on record cards having a plurality of columns, an automatic control device for changing the operation of said registering devices when record card groups change, and means for selectively coupling said control device for control by one or a plurality of record card columns selectable from the columns controlling one or a plurality of said registering devices.

32. In a tabulating machine, in combination, a plurality of registering devices adapted to receive records from the index points of various columns of perforated record cards, means for designating the group numbers corresponding to the index

points of one or a plurality of said columns, and means for automatically controlling the operation of the tabulating machine from one or a plurality of columns.

33. In a tabulating machine, in combination with a tabulating machine having record-controlled registers and an automatic control device for modifying the operation thereof upon the occurrence of group changes, means for selectively adjusting the control device for control by the index points in any one or a plurality of columns in the record card and in correspondence with any one or a plurality of columns of said register or registers.

34. The invention set forth in claim 33 in which means is provided for selectively controlling selected columns in one of said registers for setting up designations of record card groups, said columns being selectable from any one or a plurality of index point columns on the record cards.

35. In a tabulating machine having a plurality of record registers which receive records from index points on various columns of cards, means for automatically controlling the operation of said tabulating machine, means for controlling the operation of certain of said registers to cause the same to indicate the group number, and means for selecting one or a plurality of card columns for controlling and one or a plurality of card columns for group indicating.

36. In a tabulating machine, in combination, a card-controlled register having provisions for controlling the same in accordance with the index point positions disposed in a plurality of columns, upon record cards, an automatic control device for modifying the operation of said tabulating machine when record card groups change, and means for selectively adjusting said automatic control device for control by desired card columns and for adjusting the controlling means for said register for control by the same or other columns.

37. In a tabulating machine, in combination, a card-controlled register having sections thereof adapted for independent control by the index points disposed in various columns of a record card, an automatic control device for modifying the operation of said tabulating machine when record groups change, means for selectively utilizing certain sections of said register to accumulate items from certain card columns, and means for selectively utilizing certain selected card columns for automatic controlling without actuating the register.

In testimony whereof I hereto affix my signature.

CLAIR DENNISON LAKE.

March 30, 1926. Re. 16,304

C. D. LAKE

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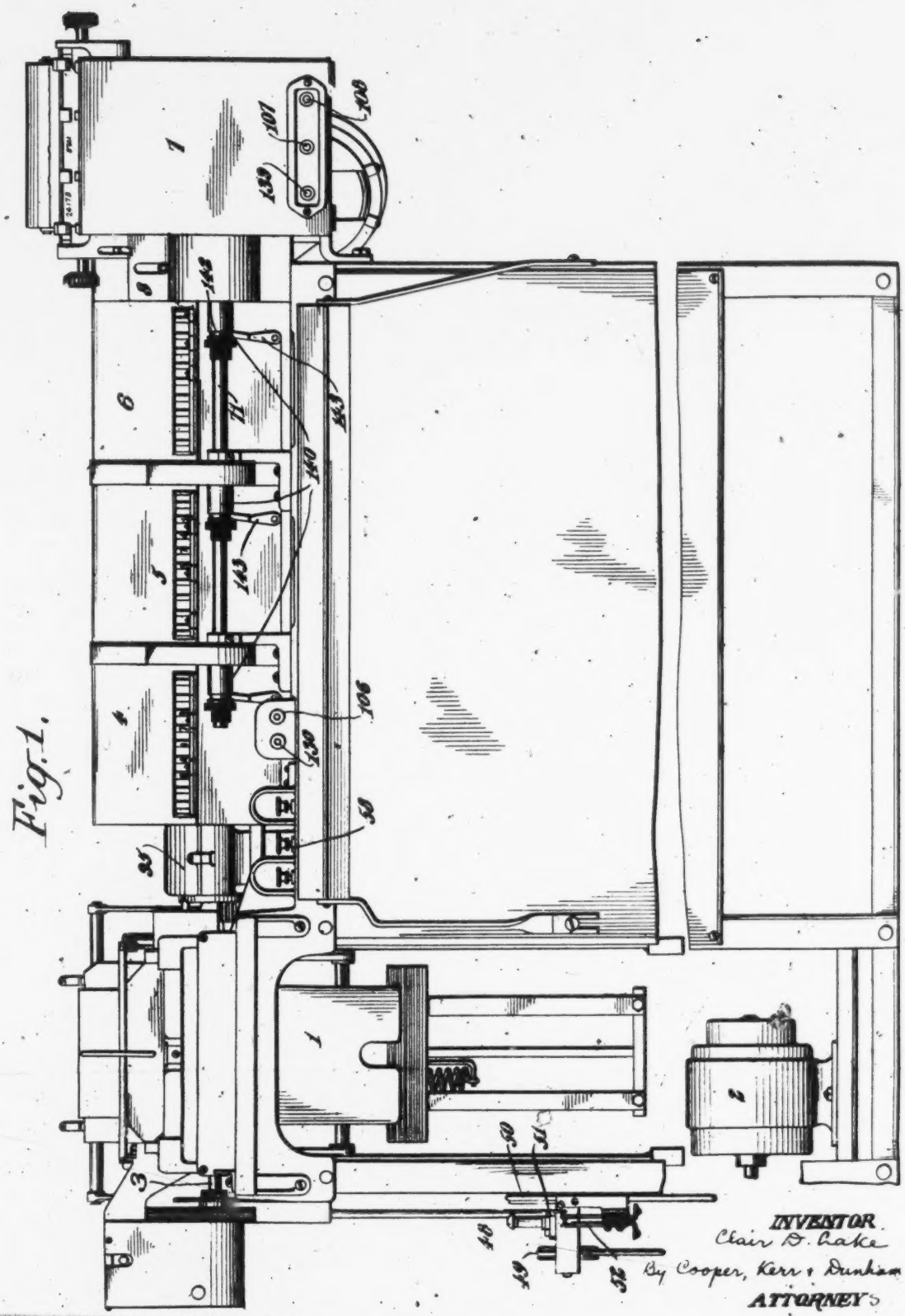

Fig. 1.

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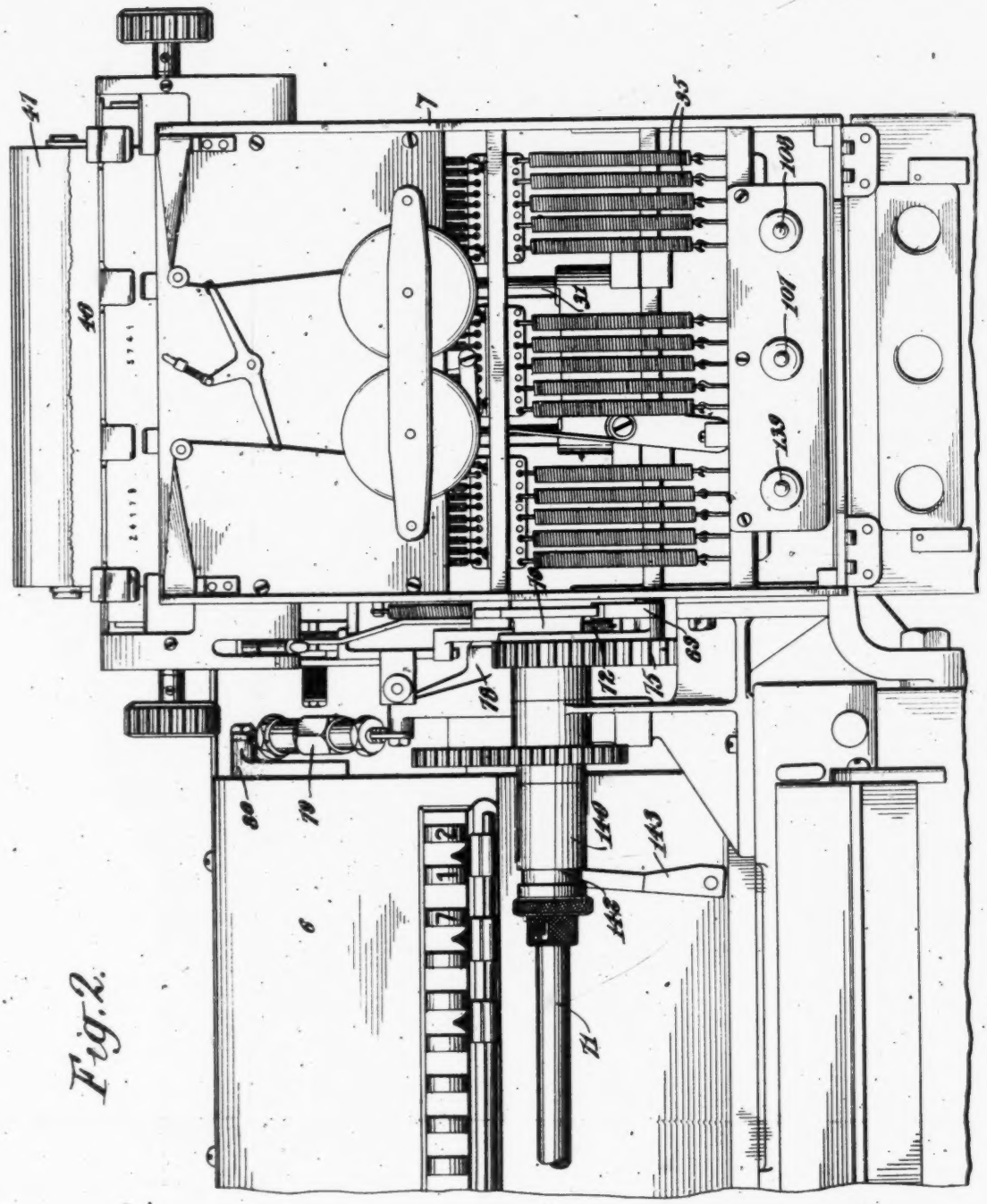

Fig. 2.

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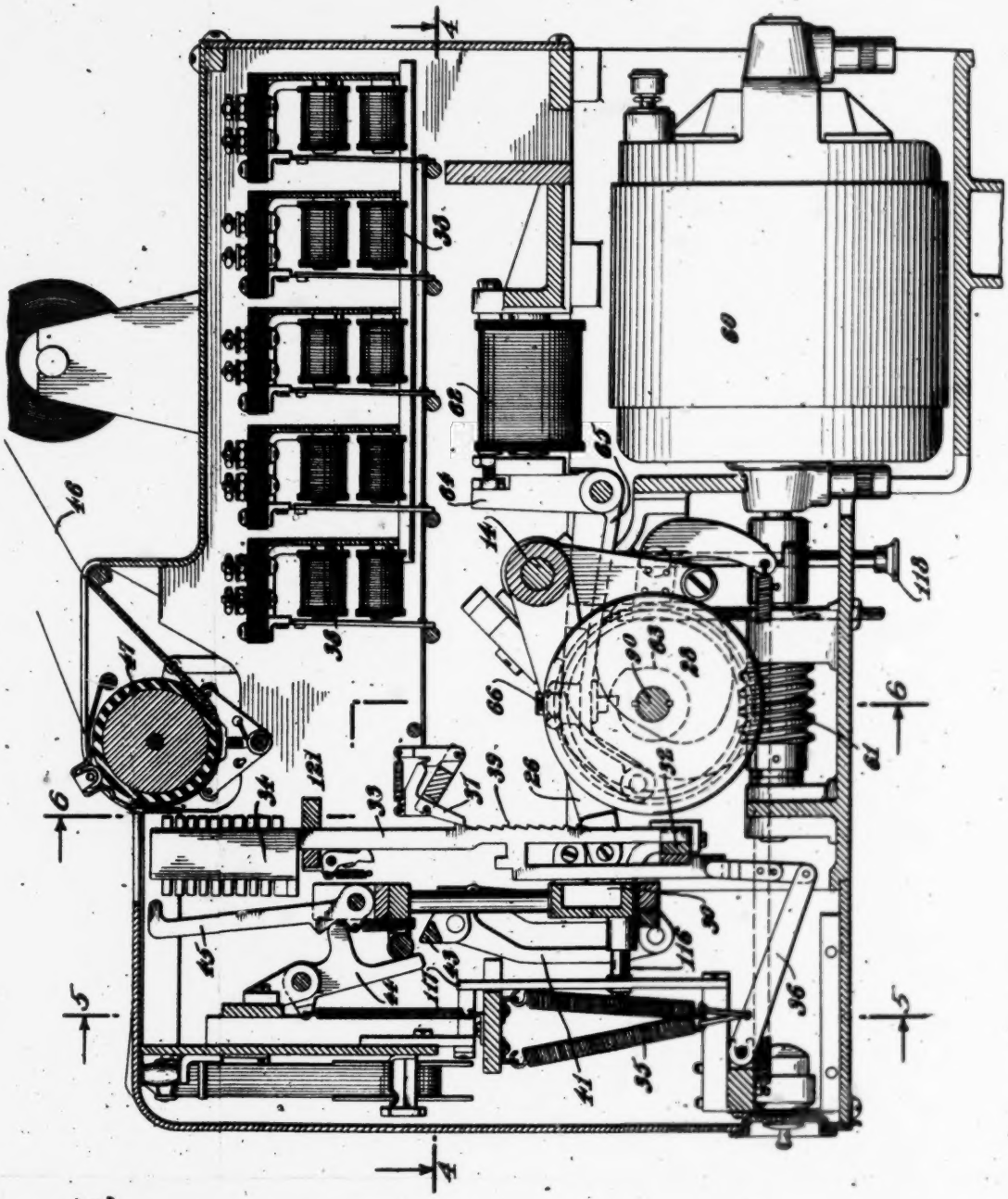

Fig. 3.

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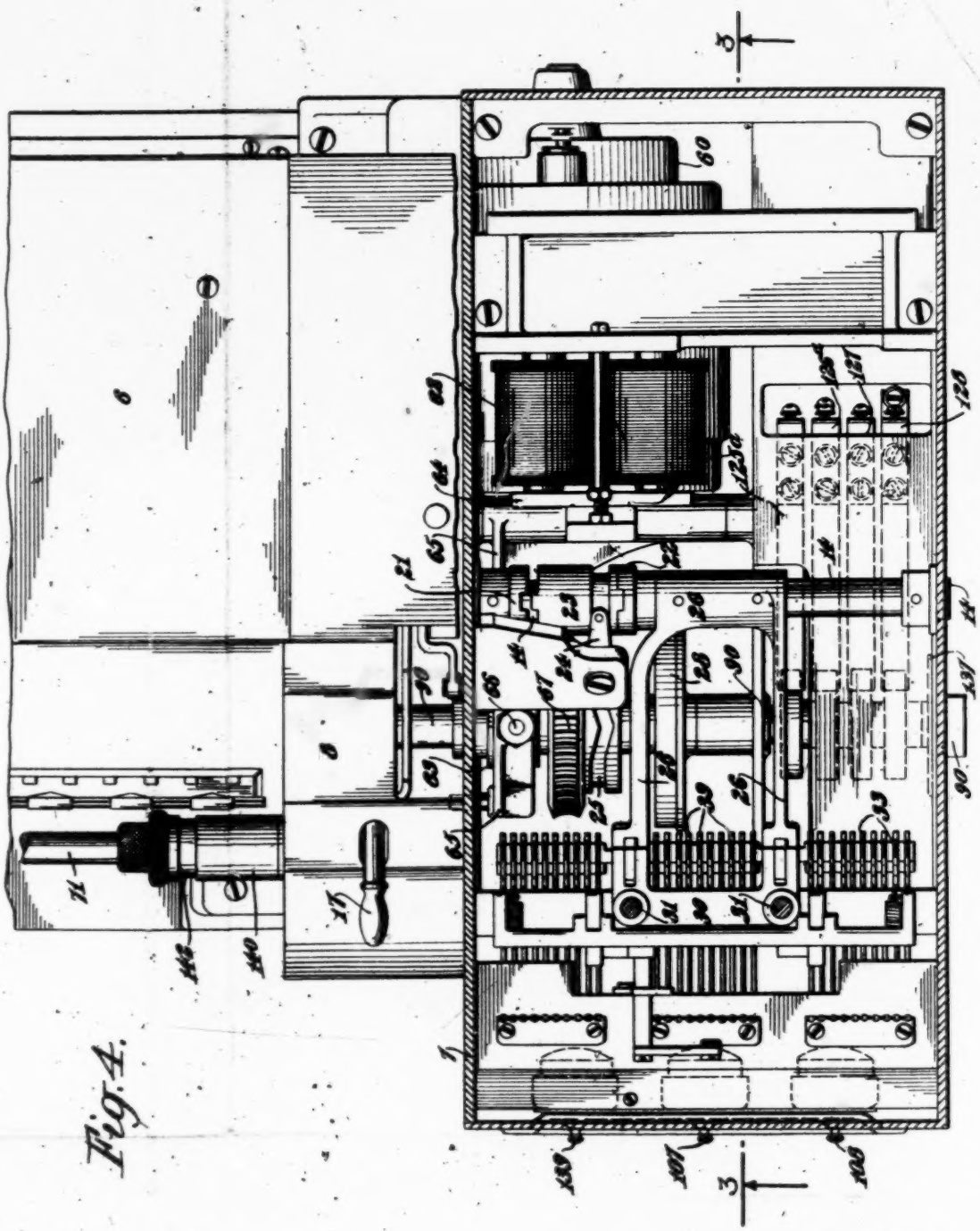

Fig. 4.

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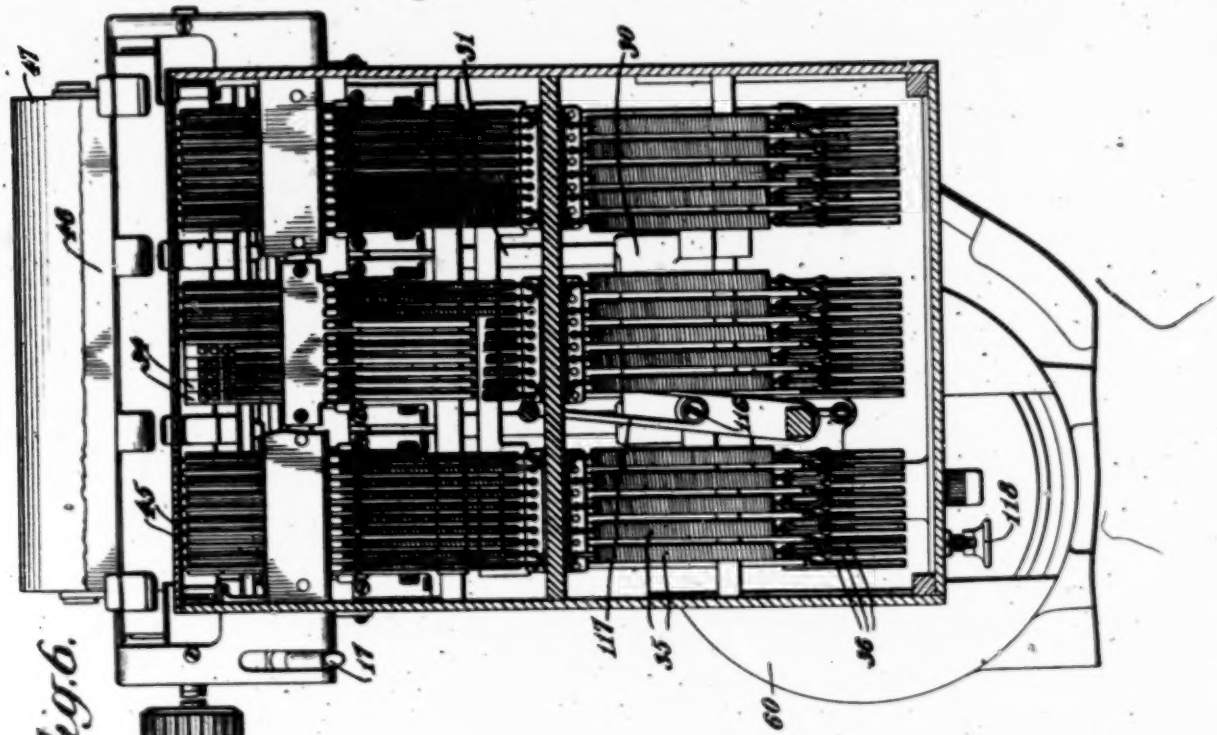

Fig. 6.

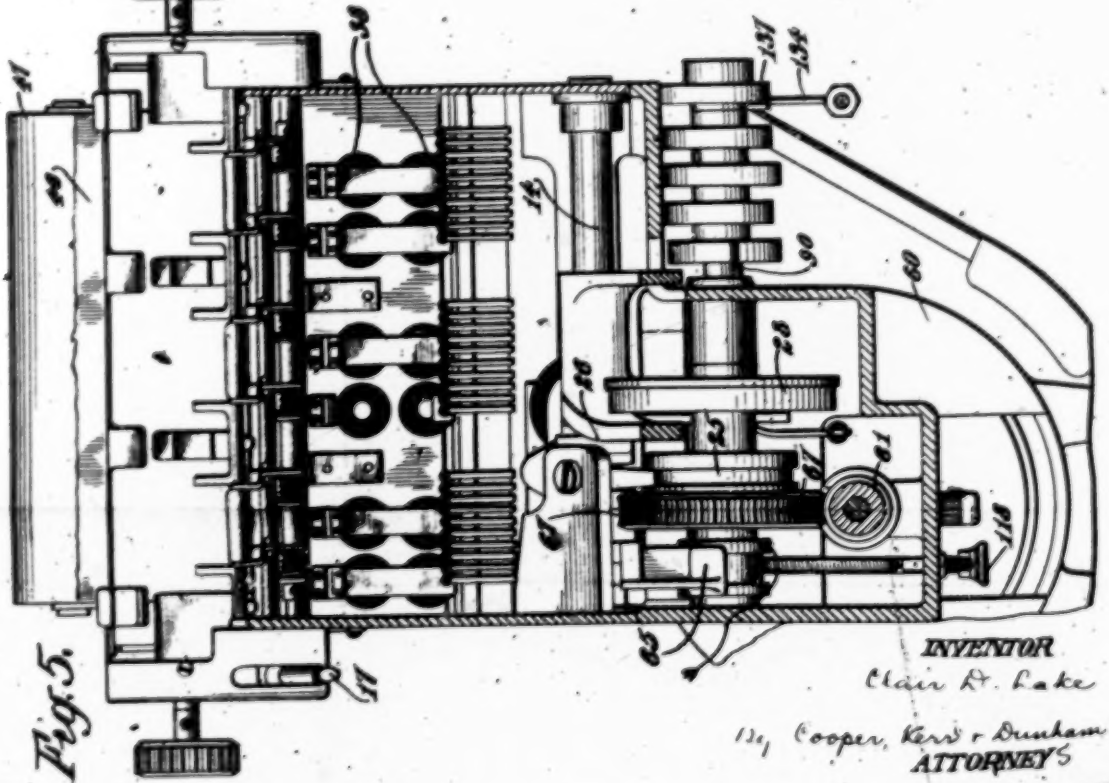

Fig. 5.

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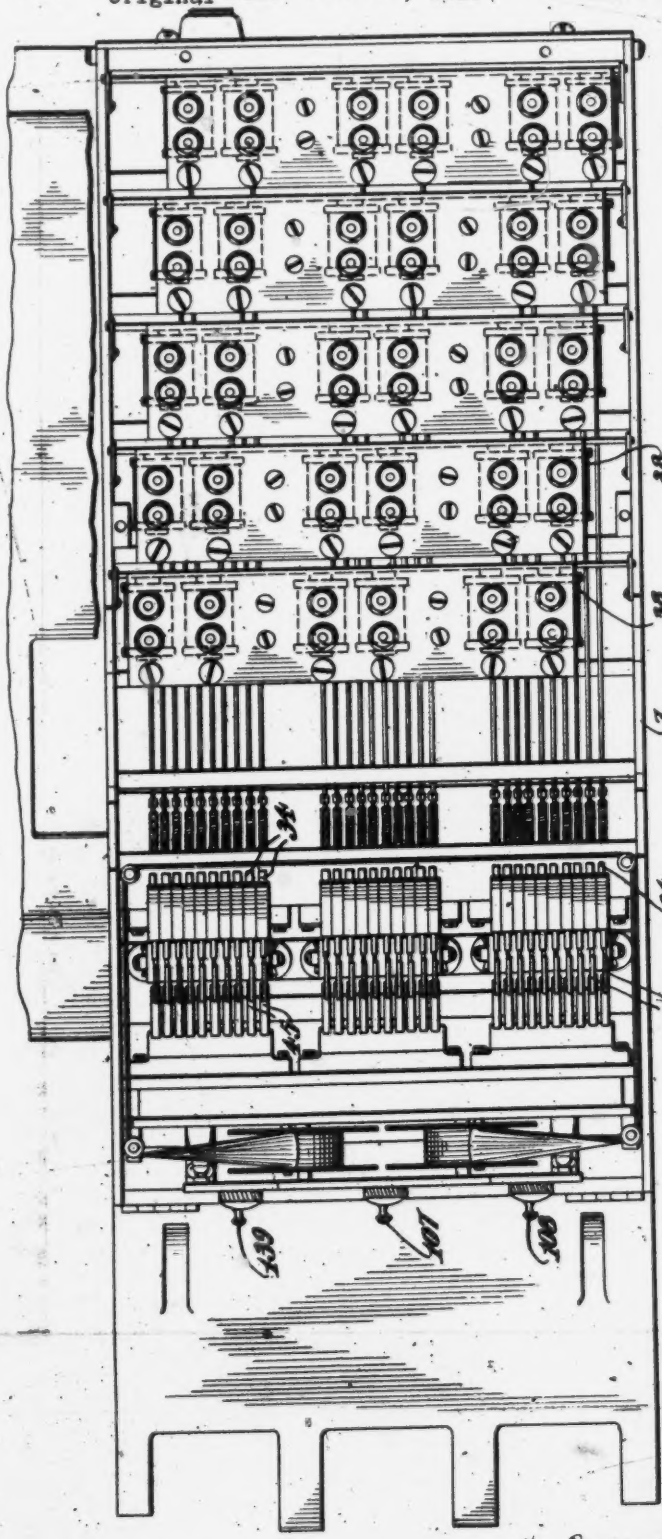

Fig. 7.

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Fig. 10.

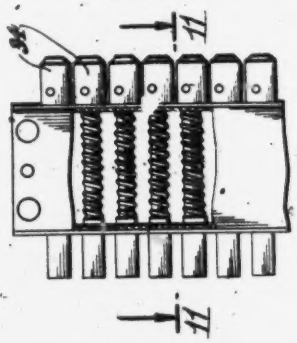

Fig. 11.

Fig. 9.

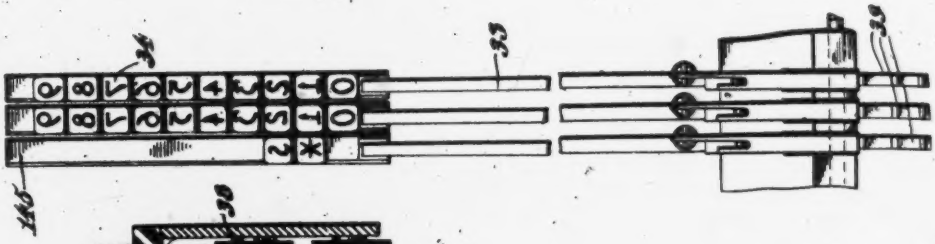

Fig. 8.

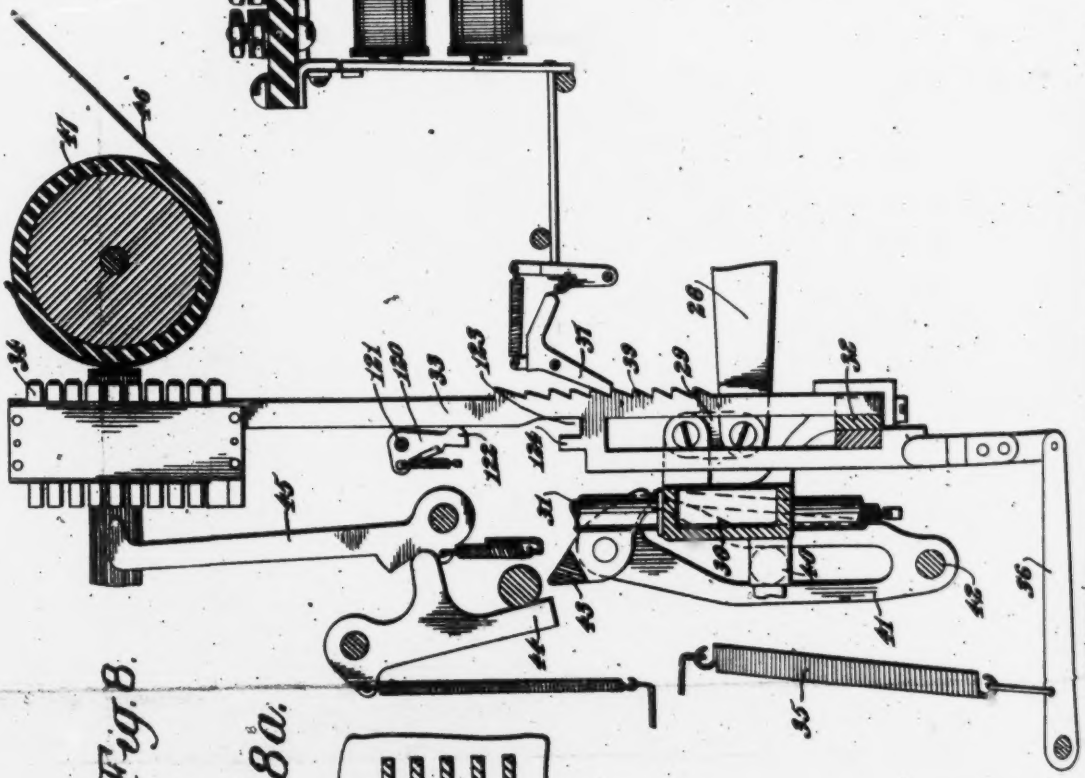

Fig. 8a.

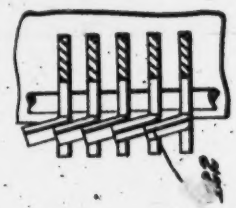

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Fig. 12.

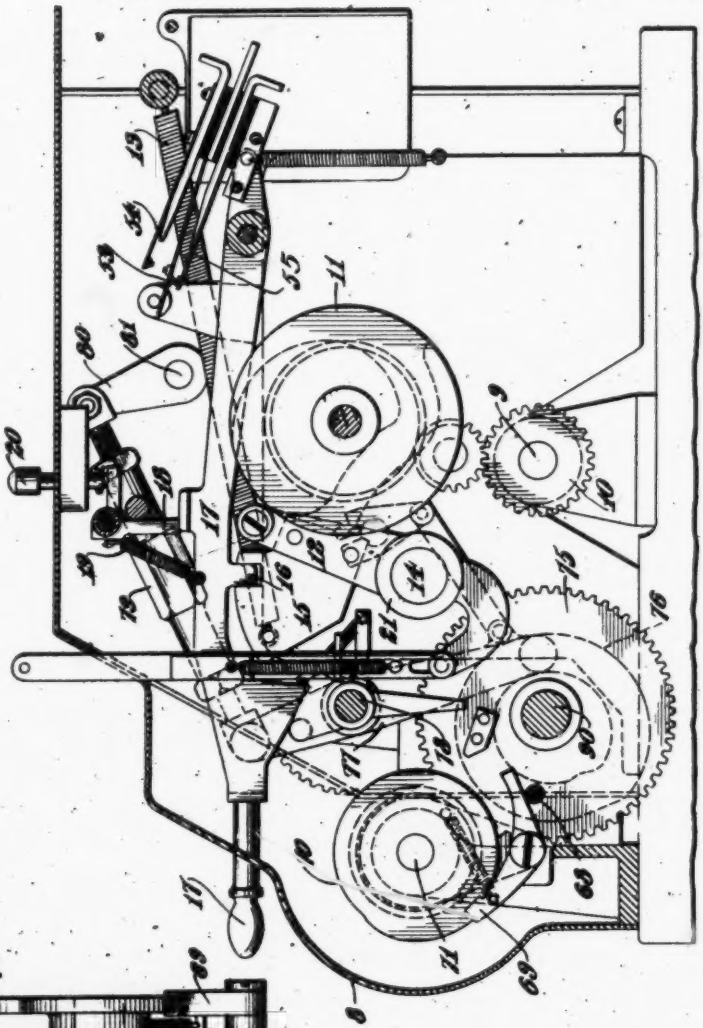
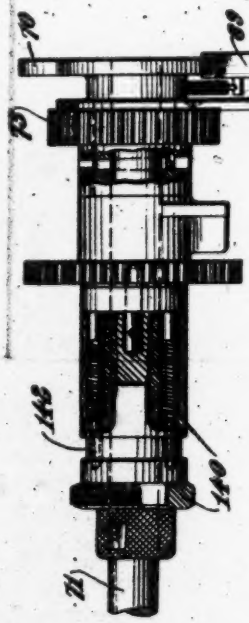


Fig. 13.



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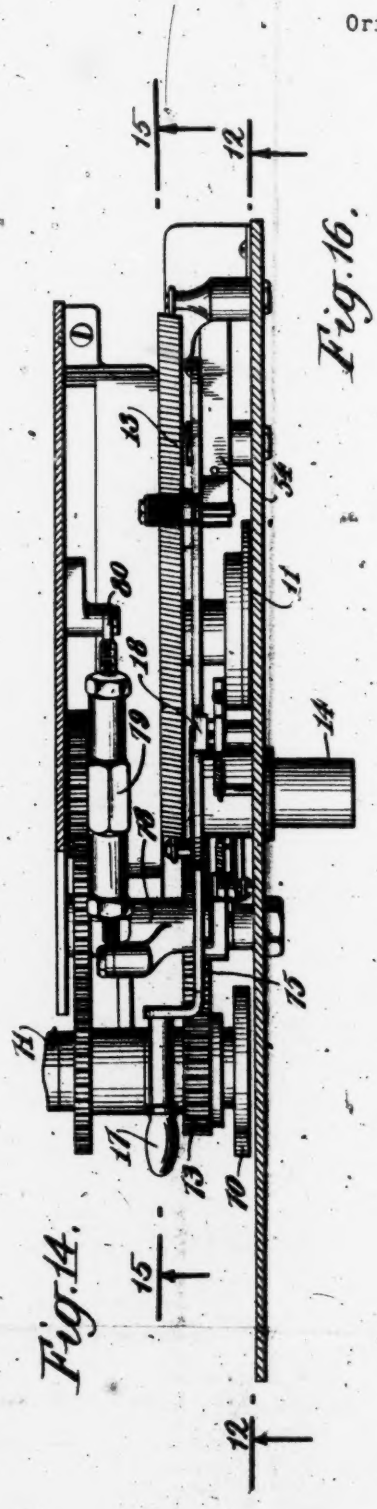

Fig. 14.

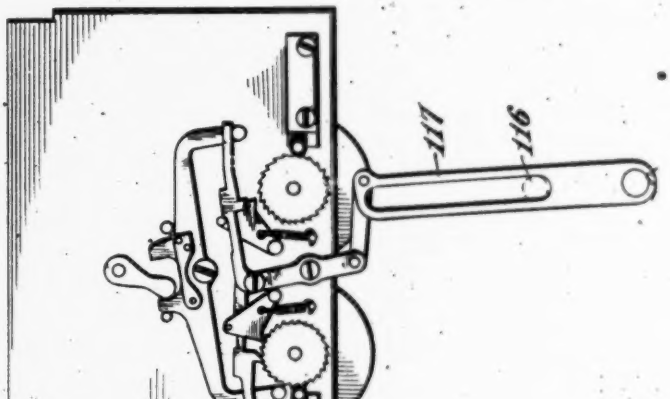

Fig. 16.

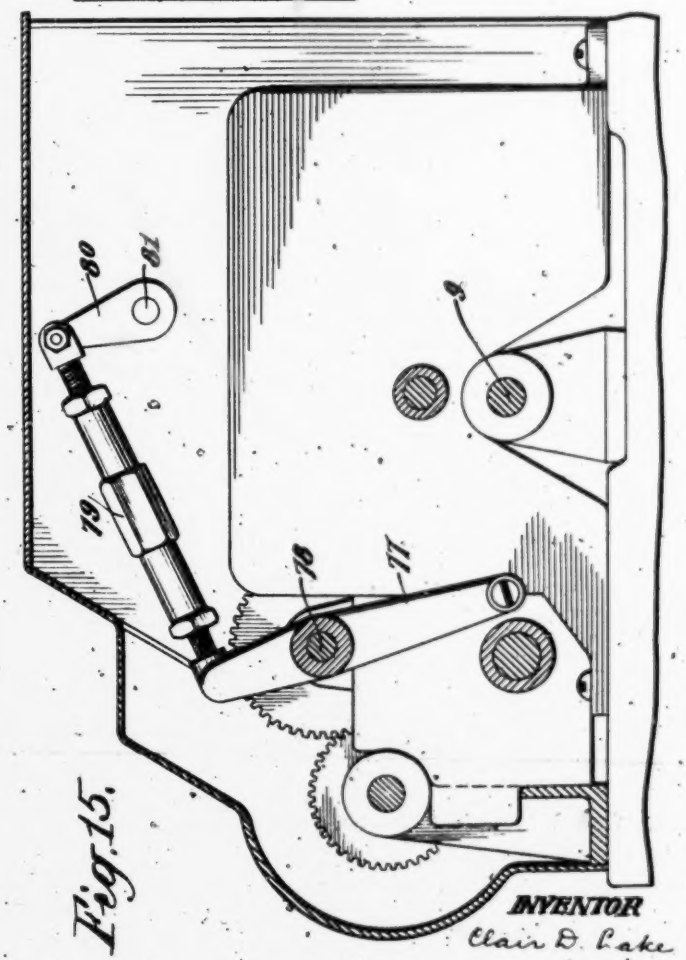

Fig. 15.

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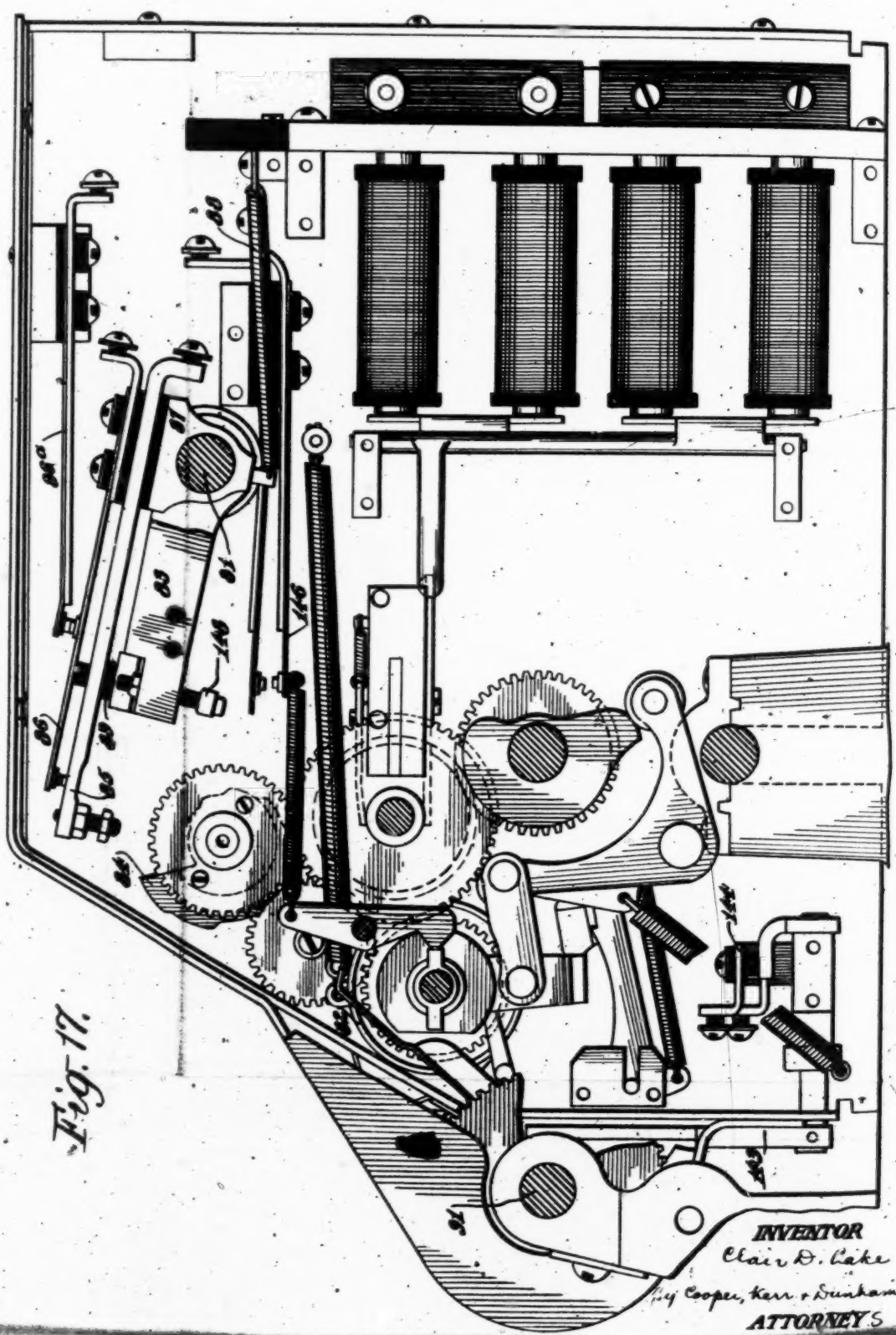

Fig. 17.

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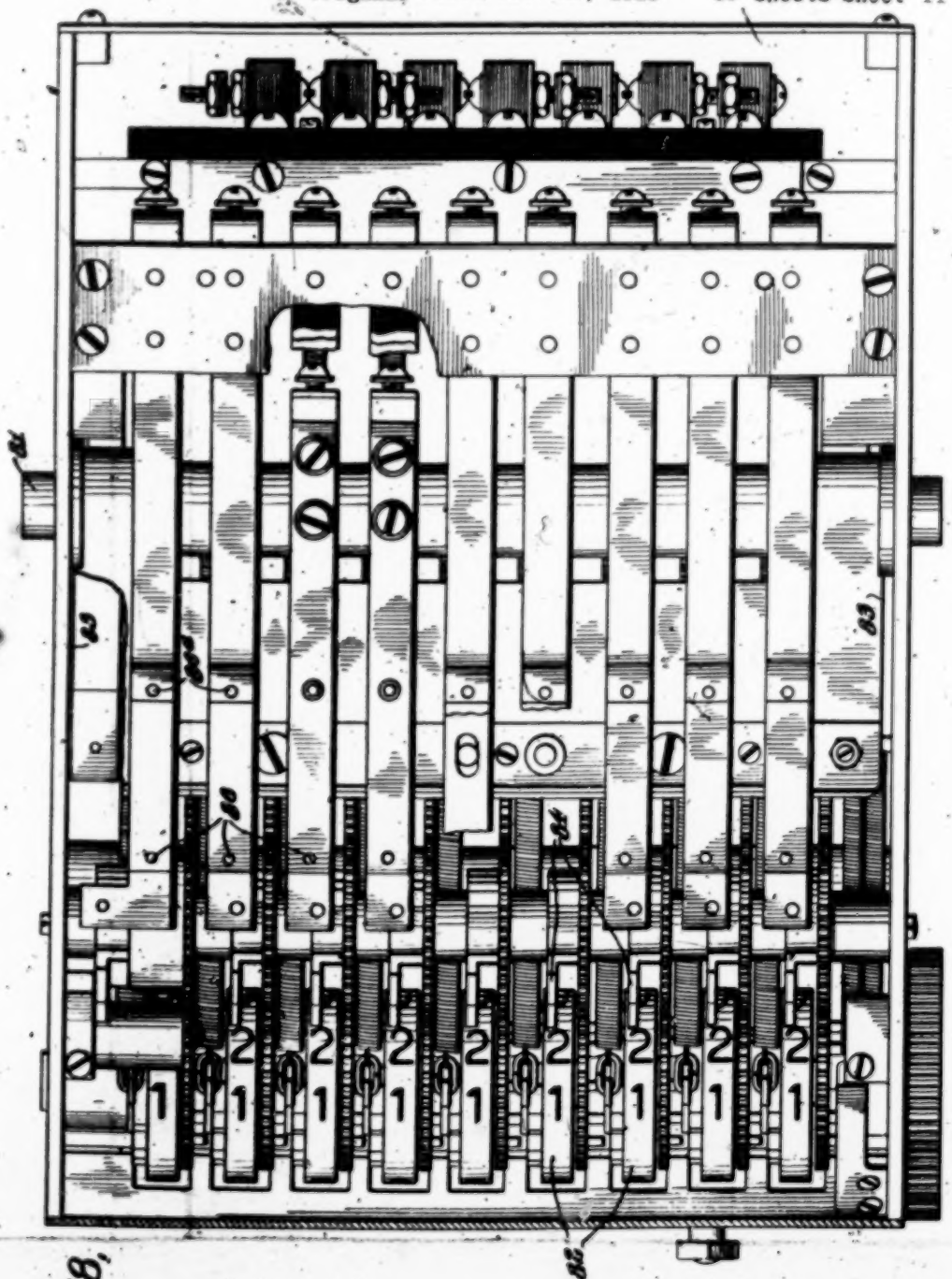

Fig. 18.

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Fig. 20.

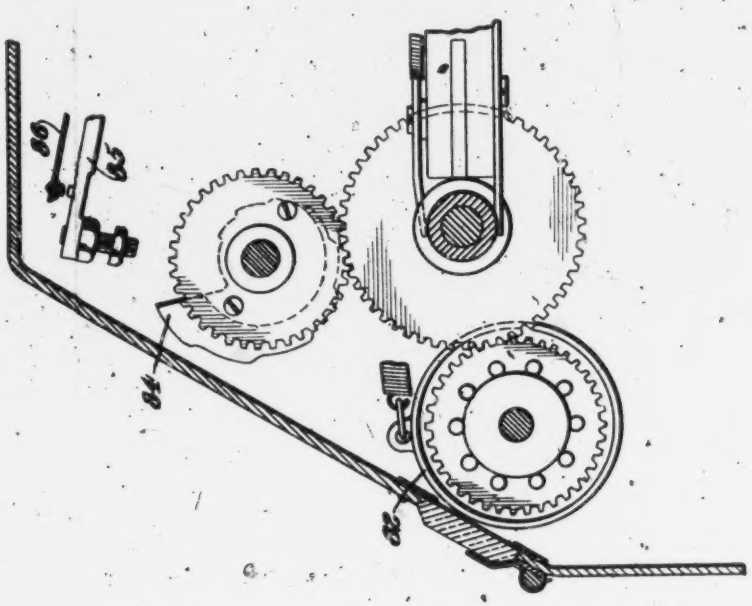
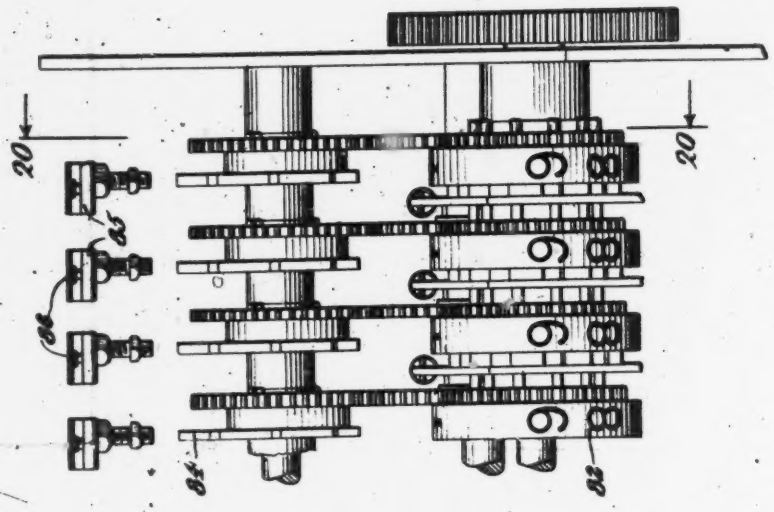


Fig. 19.



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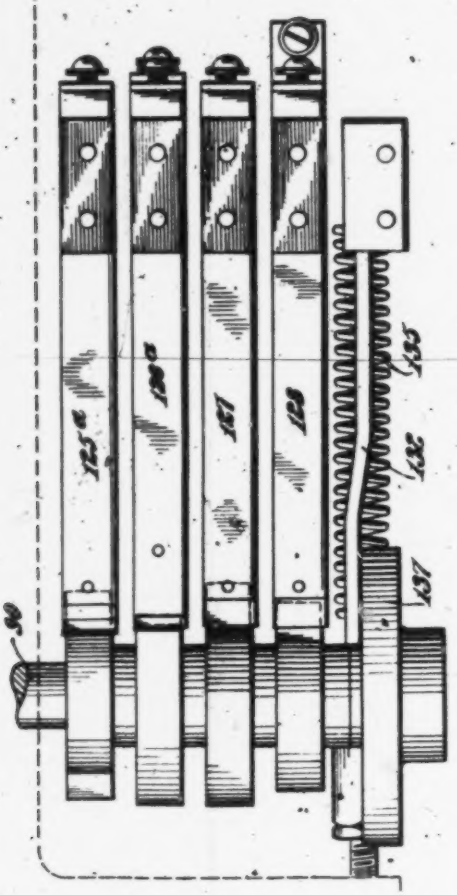

Fig. 21

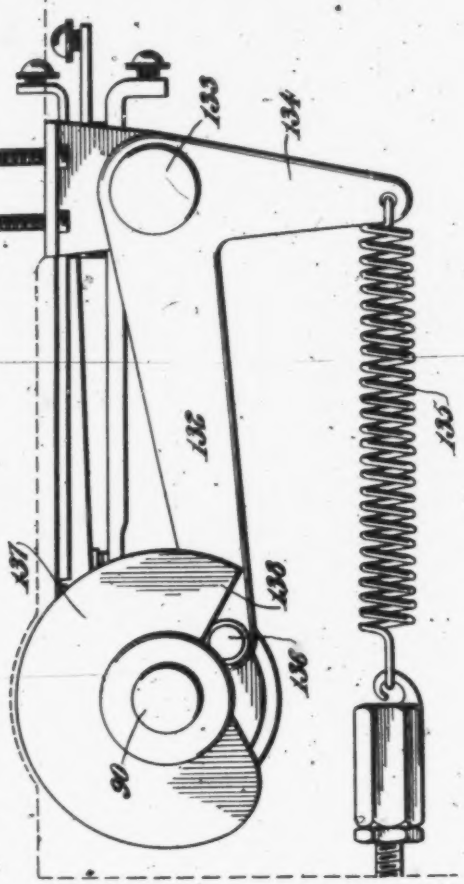

Fig. 22.

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Fig. 24.

Fig. 26.

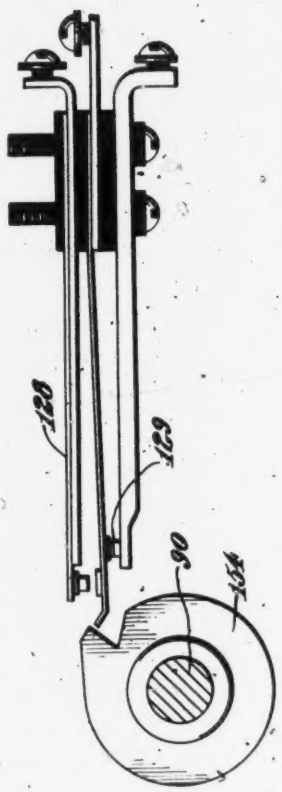
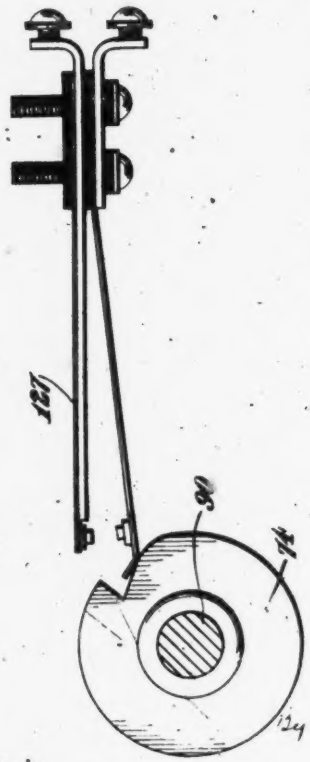


Fig. 23.

Fig. 25.



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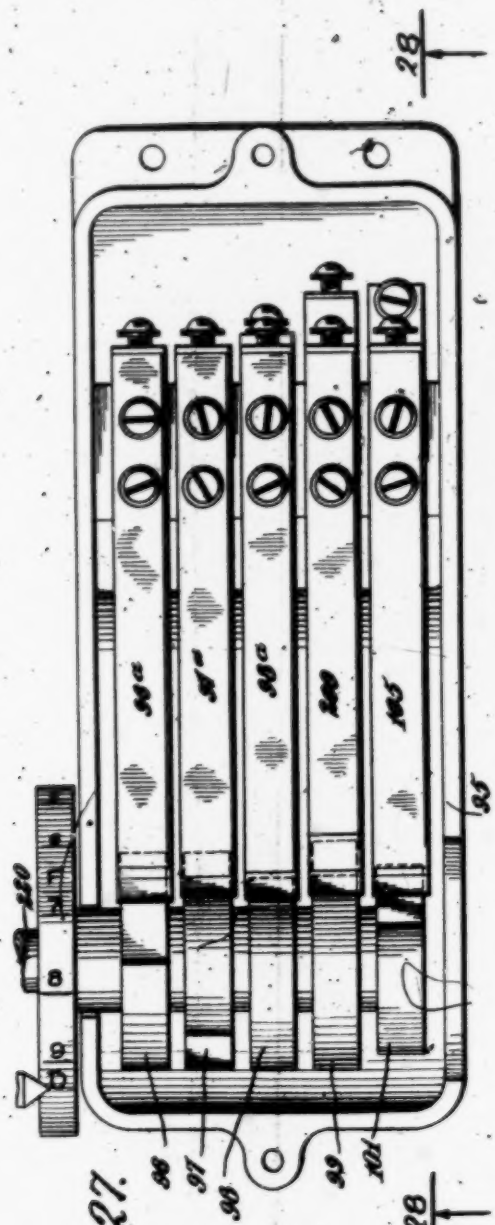

Fig. 27.

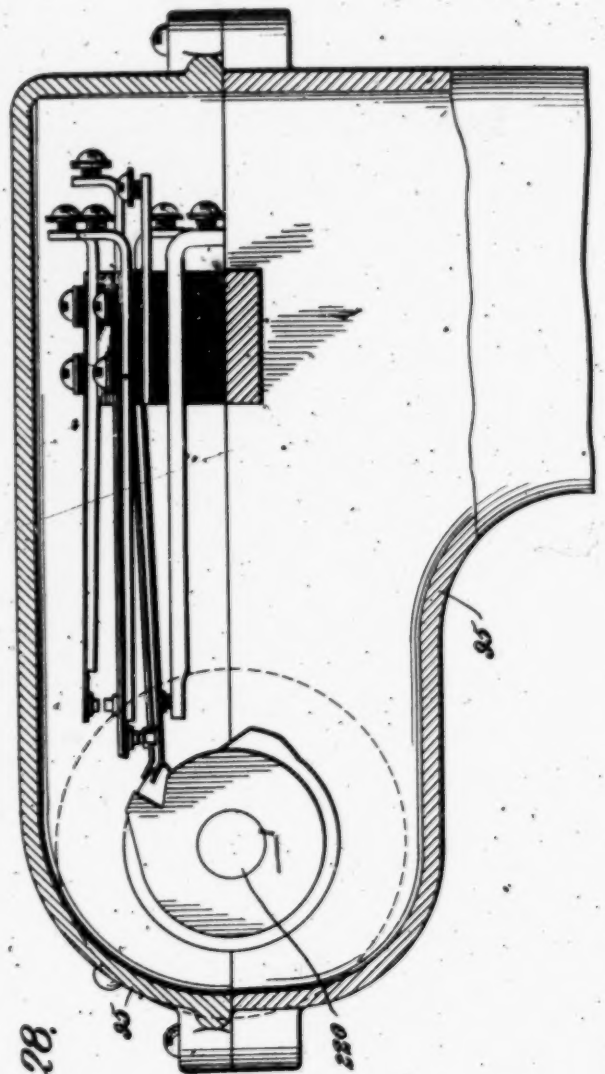

Fig. 28.

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Fig. 30.

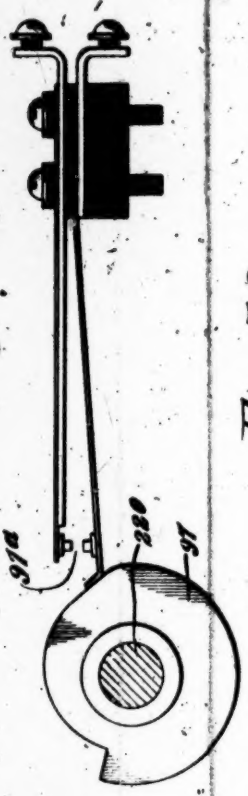


Fig. 32.

Fig. 33.

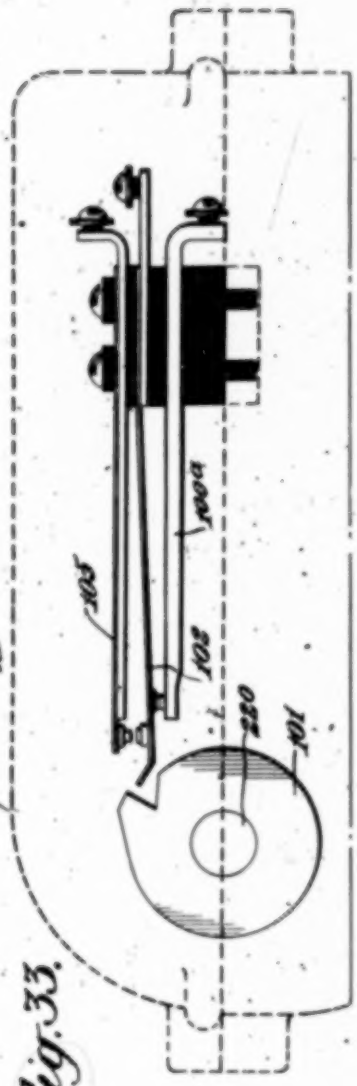
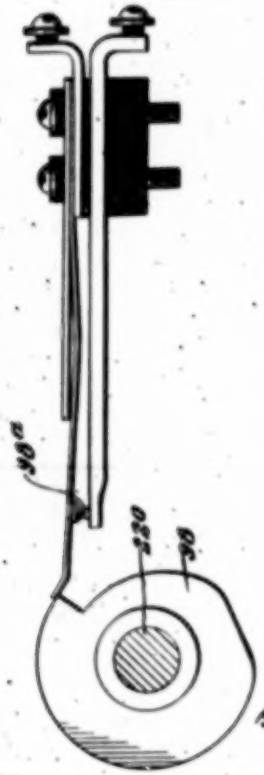


Fig. 29.

Fig. 31.



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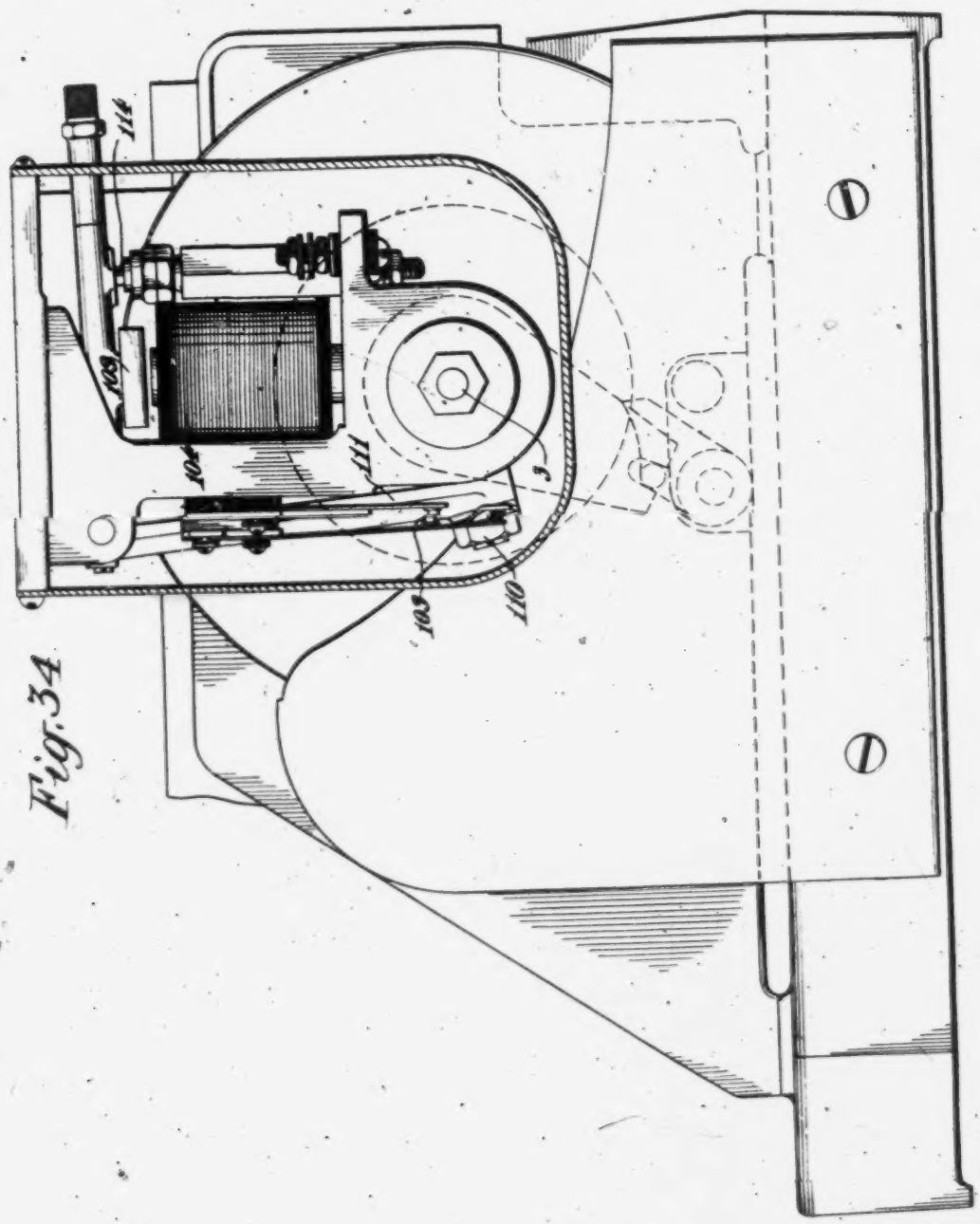

Fig. 34

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Fig. 35.

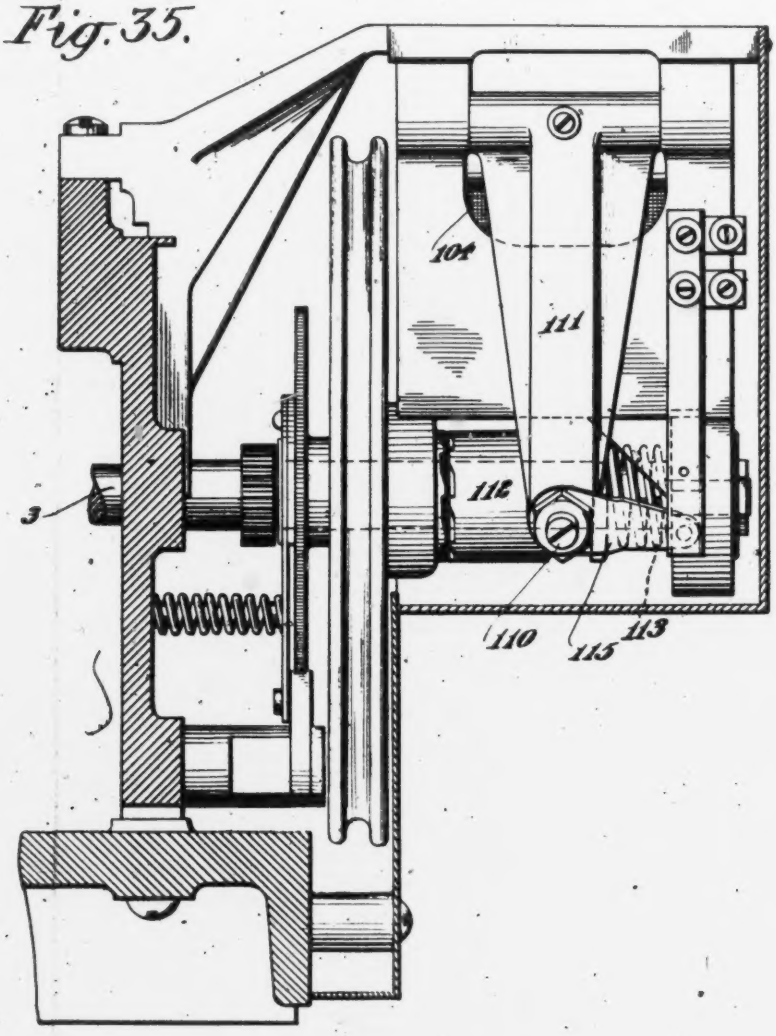

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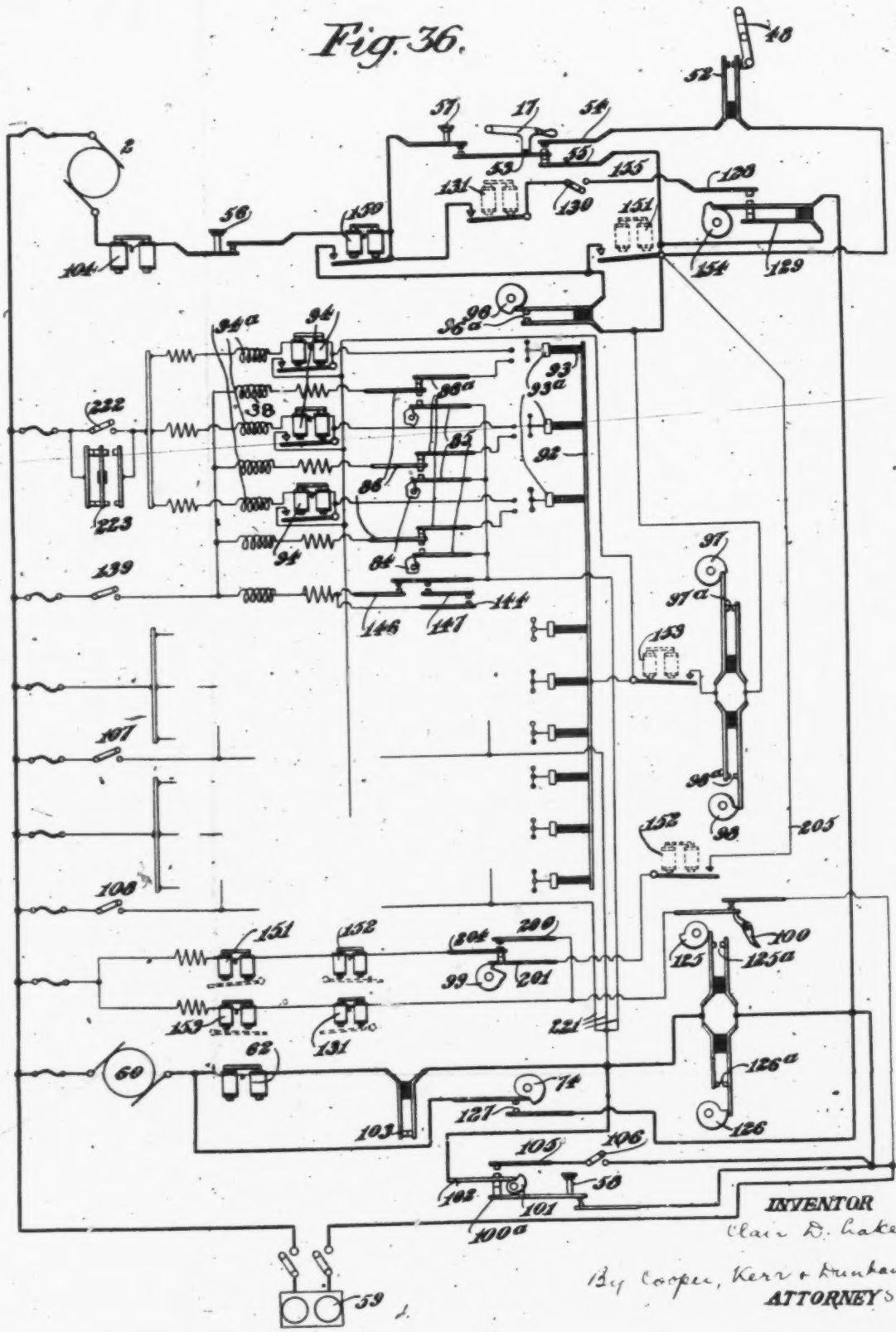
Fig. 36.



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UNITED STATES PATENT OFFICE.

CLAIR DENNISON LAKE, OF BINGHAMTON, NEW YORK, ASSIGNOR TO THE TABULATING MACHINE COMPANY, A CORPORATION OF NEW JERSEY.

PRINTING TABULATOR.

Original No. 1,379,268, dated May 24, 1921, Serial No. 348,069, filed December 29, 1919. Application for reissue filed December 3, 1921. Serial No. 519,780.

To all whom it may concern:

Be it known that I, CLAIR D. LAKE, a citizen of the United States, residing at Binghamton, in the county of Broome and State of New York, have invented certain new and useful Improvements in Printing Tabulators, of which the following is a full, clear, and exact description.

The invention which forms the subject of this application for Letters Patent is an improvement in attachments for tabulating machines, more particularly the well known and widely used Hollerith tabulator, which is typical of the general class of machines designed solely for tabulating.

This machine is set forth in numerous patents but is, perhaps, more fully shown and described in Patent No. 945,236, dated January 4, 1910.

In such machines provision is made for passing singly and in rapid succession a stack of perforated cards under a series of brushes or contacts which, encountering perforations, make contact with a conductor over which the cards pass, and thereby energize electromagnets to operate suitably designed and constructed means for indicating the data which the perforations by their number or location represent. Generally speaking, the main function of such machines is to totalize items and when a determined number of cards has been run through, the indicated totals may be read off and taken down. No provision, as a rule, is made for printing or permanently recording the individual items, as this requires more time, and a slower operation of the machine than its normal use will permit. Hence, to list the items indicated by a stack of cards, would involve the reading and recording of each figure displayed by the record wheels.

My purpose has been to extend the field of usefulness of such machines, and to provide means whereby they may be called upon, when occasion requires, to list or print the items and to print or record subtotals and totals, and in general to make a permanent record of whatever operation they may be called upon to perform. With this object in mind I have devised an attachment to a tabulator which will operate in synchronism or exact accord therewith to record each item, subtotal or grand total as the case may be, and to adapt the tabulator to listing I provide means for varying and controlling its speed whereby it must be run at a reduced speed when listing or may be run at its normal high speed when merely tabulating.

The accomplishment of this result has involved chiefly the devising of new mechanical and electrical devices, and combinations, and in these the invention resides. The general nature of the improvement may therefore be gathered from the consideration that in the tabulator proper there are a number of indicating wheels which are set to indicate the numbers corresponding to the perforations in the cards. My new attachment is capable of printing each number so indicated, or the totals of a group of such numbers, or the grand totals of several groups. It is provided with means for resetting the indicating wheels to zero after any or any number of operations, so that after resetting no totals may be preserved, or on the other hand, if not reset, a subtotal may be printed and preserved, so that the next printed total will be a grand total and so on.

As above stated, there is used a controlling device by which the speed of the tabulator is reduced when the attachment is used for listing, but if only totals are to be printed, then the machine may be set for the higher or normal tabulator speed, and the individual numbers are not printed, the totals being recorded automatically or by pressing a button, which causes the proper mechanism for the purpose to operate.

The improvement is illustrated in detail in the accompanying drawings:

Figure 1 is a front view in elevation of a conventional form of tabulator with my improved attachment associated therewith.

Fig. 2 is an enlarged view in elevation of the printing attachment showing a part of the tabulator. The cover of the attachment is removed to exhibit the general internal arrangement.

Fig. 3 is a sectional view of the attachment taken on the line 3—3 of Fig. 4.

Fig. 4 is a sectional view of the same on the line 4—4 of Fig. 3.

Fig. 5 is a section on line 6—6 of Fig. 3.

Fig. 6 is a section on the same on line 5—5 of Fig. 3.

Fig. 7 is a top plan view of the attachment with the paper roll and cover removed.

Fig. 8 is an enlarged detail of the means for setting the printing type carriers and effecting the printing.

Fig. 8ª is a detail of a zero control device, shown in Fig. 8.

Fig. 9 is a view in side elevation on an enlarged scale of the printing type carriers.

Fig. 10 is a detail of a portion of the type carrier.

Fig. 11 is a detail of a type on the line 11 of Fig. 10.

Fig. 12 is a side view of the upper portion of the mechanism in the tabulator taken on line 12—12 of Fig. 14.

Fig. 13 is a detail view partly in section of a part of the tabulator mechanism.

Fig. 14 is a top plan view of the intermediate portion of the tabulator and its printing attachment.

Fig. 15 is a sectional view of the same parts on the line 15—15 of Fig. 14.

Fig. 16 is a detail of the ribbon feeding mechanism for printing from the type.

Fig. 17 is a vertical section through one of the counters of the tabulator.

Fig. 18 is a top plan view of the indicating wheels of the tabulator and the contacts which control the printing mechanism.

Fig. 19 is a detailed front view of the tabulator counter wheels and controlling mechanism for the total printing devices.

Fig. 20 is a section on the line 20—20 of Fig. 19.

Fig. 21 is a plan view of cams and contacts in the printing attachment, the contacts being those controlling during the printing and resetting portion of the cycle.

Fig. 22 is a side view of the same parts.

Figs. 23, 24, 25 and 26 are detail views of certain cams and contacts employed in the tabulator printer attachment.

Fig. 27 is a plan view of a cam box and contacts operated by the tabulator.

Fig. 28 is a sectional view on the line 28—28 of Fig. 27.

Figs. 29, 30, 31, 32 and 33 are detail views of cams and contacts used in the tabulator.

Fig. 34 is an end view of the tabulator clutch mechanism.

Fig. 35 is a side view of the same, and

Fig. 36 is a diagram of the circuit connections and an illustration of the relations of the several parts of the apparatus.

Similar reference numerals in all of the above figures are employed to designate corresponding parts thereof.

The tabulator proper is well known in the art and requires but little further description than will be given incidentally herein. In Fig. 1 the card-controlling portion 1, the driving motor 2, the counter shaft 3, and the counters 4, 5 and 6 are shown in their normal relations. As is well known, as the perforated cards are passed through the machine, one or more of the counters are operated to show the figures or the totals of the figures represented by the perforations in said cards.

My improved printing attachment for such a tabulator is designated by the numeral 7, and between this attachment and the tabulator is a casing 8, a part of the interior mechanism in which I shall now describe by reference to Figs. 12, 14 and 15.

In these figures the shaft 9 is driven by the tabulator motor 2 and carries a gear 10 which imparts rotation to a cam 11 upon the cam surface of which travels a lever 12, with a roller at its end and actuated by a spiral spring 13. The lever 12 oscillates a loose hub 21 on shaft 14 with which hub it is integral or to which it is fixed, and it has attached to it a plate 15 having a notch 16. When the machine stops after any cycle of operation this notch by reason of the fact that the lever acts on the higher point of the cam, is immediately under a projection on a pivoted handle or lever 17, the end of which projects out through a slot in casing 8. When it is not desired to list, this handle is depressed, locking the lever 12 against movement, so that it does not follow the cam 11, and at the same time lever 17 itself is locked down by a bell crank catch 18 actuated by a spring 19 and may not be again raised until a push button 20 is forced down to release the bell crank catch.

In the printing casing 7 the shaft 14 extends as shown in Fig. 4 and carries in addition to the hub 21 a second loose hub 22 and both ends 21 and 22 have teeth or notches therein. Intermediate these hubs is a sliding notched sleeve 23 keyed to the shaft and adapted to be moved from engagement with one hub 22 to the other 21, or conversely, by means of a lever 24 oscillated by a cam groove in a disk 25 fixed on shaft 90.

Pinned to the shaft 14 is also a double lever 26 (see Figs. 3, 4 and 8) which partakes of the oscillatory movement of said shaft, and is thus raised or lowered according to whether the keyed sleeve 23 engages with hub 21 to which the lever 12 is secured, or whether it engages with the hub 22, integral with which is a lever or arm 27 which bears upon and is oscillated by a cam 28 fixed on the shaft 90.

The normal position of the sleeve 23 is in engagement with the hub 21, and this must be the case when the machine is used for listing. By means to be hereinafter described, the lever 24 throws the sleeve 23 into engagement with hub 22 when a total

is to be printed from which it follows that in listing the shaft 14 is oscillated by the lever 12, but in total printing by lever 27.

Referring now to Fig. 8, the ends of the oscillatory lever 26 are connected by links 29 with a cross head 30 movable over vertical rods 31, and imparts vertical movement thereto. Extending from the cross head 30 are arms carrying a bail 32 which extends through a plurality of slotted bars 33 equal in number to the counter wheels of the tabulator and each carrying a series of ten sliding type 34. Normally the bars 33 are drawn upward by spiral springs 35 connected to them through links and lever 36 and therefore are in contact with the bail 32 and follow the upward movement of the latter imparted by lever 26 until arrested by pawls 37 operated by the magnets 38, and engaging in one of a series of notches 39 in the side edge of the bars 33. The spacing of the notches 39 corresponds with the spacing of the movable type 34 and the movement of the bars under the influence of the levers 26 is synchronous with the movement of the perforated cards through the machine, so that when a perforation is encountered by a brush in the tabulator, the corresponding magnet 38 is energized, as will be hereinafter set forth, and the bar is stopped at a point in its upward travel which brings the type corresponding to such perforation into the printing position and holds it there until after the printing.

The cross head 30 has rearwardly-extending projections 40 with rollers which work in slots in plates or levers 41, pivoted at 42 and as the cross head rises these levers, by reason of the conformation of the slots, are forced back, thereby swinging a bail 43 to the left into engagement with pivoted spring actuated levers 44, forcing the same back and allowing a series of pivoted spring actuated printing levers 45 to swing away from the type carried by the plates or bars 33. At the limit of upward movement of the cross head 30, however, this bail 43 is turned down and slips off from the ends of levers 44 and these being suddenly released are thrown by their springs forward, thus driving the printing levers forward with sufficient force and momentum to strike either a type or the blank point on a type carrier. A type thus struck, strikes the paper 46 on a roller 47 and prints thereon the proper figure.

By the means above described it will be seen that every perforation in a proper card will cause to be set at the printing position and printed on a sheet of a paper a figure corresponding to that perforation, in addition to tabulating the same figures in the usual and ordinary way on the counters. It is necessary, however, when listing or printing in this manner to provide for a slower operation of the machine than for tabulating only; for printing totals and subtotals; for resetting all parts to zero at certain desired times and for performing certain other operations and I shall now describe the means which I have devised for accomplishing these operations.

On the tabulating portion of the machine, see Fig. 1, is a lever or handle 48 which, by its actuation of any well known form of mechanism, imparts to the machine a slower or a faster speed. For example, when shifted to the left this handle throws in a belt operating a small pulley 49 which drives the machine at a relatively high speed and when shifted to the right throws in a belt operating a large pulley 50, which drives the machine at a slower speed. In the present case the slower speed is used when the machine is listing, and the higher speed when tabulating only.

The handle 48 carries an arm 51 which controls in its movement the contacts 52 and on low speed these contacts are brought together. By reference to Fig. 12, it will be seen that when the lever or handle 17 is raised a central contact strip 53 comes into engagement with an upper contact 54, but when the handle is lowered this central contact engages a lower contact 55.

The diagram (Fig. 36) shows the circuits of a well known Hollerith tabulator with certain supplementary circuits and controls which pertain to the printing attachment and its cooperative control with the tabulator.

As customary in this type of machine, the circuit of the tabulating motor 2 is provided with a clutch magnet 104 (Figs. 34–36), an emergency stop key 56 and a manual starting key 57. The usual motor relay 150 is likewise provided. 94 represent the counter brush relays and 94ª the counter magnets. As is customary in tabulators these magnets and relays are adapted to be coupled by plug connections to the contact blocks 93ª and through the controlling cards to the brushes 93. In tabulators having my novel printing attachment these contact blocks may also be connected to the printing or listing magnets 38. 100 is the so-called card lever which is customarily used in machines of this type to interrupt the operation of the tabulator when there are no cards in the machine or when a so-called stop card passes the lever. Such stop cards are usually placed between groups of cards of different group characteristics. For a further description of such stop card, reference may be had to Hollerith Patent No. 1,087,061.

The card lever circuit includes a cam contact device 99, 200—201—204 which will be more fully described hereafter and this contact device cooperating with card lever 100

is arranged to bring into circuit or cut out of circuit relays 151, 152, 153 and 131 at the proper time in the operation of the machine.

The counter circuit to relays 94 and the printing circuit to magnets 38 when listing is arranged to be interrupted at the end of the passage of a card and closed at the intial passage of a new card by cam contacts 97—97ª and 98—98ª which work conjointly for this purpose.

All of the foregoing broad features with the exception of the circuits to the printing magnets 38, are common and well known in the Hollerith machine and reference may be had to Hollerith Patents Nos. 945,236 and 1,087,061, for a fuller understanding of the same. It is sufficient to here state that when the tabulator is in operation, perforated cards are passed successively between a series of brushes 93 connected to a common conducting plate 92 and the contact blocks 93ª which are plugged by plugboard connections into circuits containing counter brush relays 94 and control magnets 94ª (and also the printing and listing magnets 38). Whenever a brush, therefore, comes over a perforation in a card the foregoing counter magnets are operated to perform their allotted fuctions and control the registering and counting operations. In addition the printing magnets 38 are energized and deenergized to control the printing or listing operation as previously described.

Although the usual circuit cycle of a Hollerith tabulator is well known in the art a brief description of the same will make more clear the printer circuit operation which will be described in connection therewith.

To start the tabulator without listing handle 17 is placed in lower non-listing position. The start key 57 is then depressed. Current then flows through the tabulator motor 2, clutch magnet 104, stop key 56 (closed), motor control relay 150, key 57, 53 and lower contacts 55, lower contacts 129 (now closed), to the line. The tabulator then starts in operation and the main motor circuit is held after 57 is opened by relay 150 which establishes a circuit through cam contacts 96ª (now closed), through cam contacts 129 (closed) to the other side of the line.

In the diagram the contacts 96ª are shown open. This is the position they assume at the stop or D car position. As shown in Fig. 29 immediately after starting by the start key or otherwise these contacts become closed by cam 96 on shaft 220 operated by a tabulator drive shaft 3. During tabulating operations this circuit to the tabulator motor is maintained either through contacts 96ª or by the energization of relay 151 which closes a circuit around these contacts. Under running conditions with regular cards this relay will be energized to maintain the circuit when contacts 96ª are open, which occurs once for each card cycle. Relay 151 is controlled in the following manner. At the time of starting the mahine, the first card will close contacts through card lever 100. At the D or starting positions contacts 201 and 204 are closed by tabulator cam 99. Shortly after starting these contacts are broken. Current does not flow through relays 151 and 152 until cam 99 has rotated far enough to close all contacts 201, 200 and 204. This closure energizes relays 151 and 152 and thereafter this circuit is maintained by the holding circuit 205 controlled by relay 152. Further rotation of cam 96 breaks contacts 200 and 204 but contacts 201 and 204 remain closed during the remainder of the card cycle. Relay magnet 151 therefore remains energized and maintains the tabulator motor circuit at the time cam 96 breaks contacts 96ª. It will be understood that on the next card cycle at time contacts 201 and 204 and 200 are broken relay magnets 151 and 152 will be de-energized and the tabulator motor circuit maintained by contacts 96ª.

The tabulating operation continues until after the last card or a stop card having a notched corner passes the card lever 100. At this time, at the beginning of the stop card cycle or during a no card cycle, card lever contacts 100 will be open and consequently upon the breaking of lower contacts 201 and 204 the circuit through relay magnets 151 and 152 will be interrupted and will not be re-established since the re-energization is controlled by the making of the circuit through upper contacts 200 and 204. At the time of reclosure of 200 and 204, the controlling contacts are in a dead circuit controlled by the now opened card lever 100 and therefore they cannot cause a re-energization of the relay magnets 151 and 152. The tabulating machine will, however, complete its cycle until interrupted by breaking of contacts 96ª when it will be brought to a stop at the D position.

If instead of a straight tabulating operation, it be desired to list, handle 17 is placed in upper position thereby interrupting the starting circuit from key 57 by opening contacts 53—55. However a circuit will be made through contacts 53—54 with contacts 52 which it will be remembered are only closed when lever 48 is shifted over to cause the tabulating machine to operate at the lower listing speed. With this circuit thus established the tabulator is started in the same manner as before by start key 57. This control prevents starting and running of the tabulator if the parts are not properly adjusted for listing.

Assuming that the tabulator has been running and has completed an accumulation of items from a group of cards and been stopped by the stop card coming under the card lever; a printing of a total and the

resetting of the counters of the tabulator may be affected in several ways. The tabulating machine can come to a stop and total printing may be brought about by a manual operation involving the pressing of the total print or reset key. Or if desired, the parts can be so adjusted that as the tabulator comes to a stop automatically operable means is called into action which sets the total printing and resetting means into operation. The first manually controlled method of taking a total will be now described and hereafter a description will be given of the means for taking the total automatically.

It will be assumed that the tabulating operation is complete and the tabulator stopped in the manner previously explained. To take a printed total the operator depresses reset key 58 which connects reset motor 60 in a circuit traced as follows: from source 59, through reset key 58, contacts 100ª—102 now closed, contacts 103 now closed, reset clutch control magnet 62, motor 60, and back to source.

Contacts 103 are used to prevent the starting of total taking or resetting during a tabulating operation. These contacts are controlled by magnet 104 which is energized at all times when the tabulator is in operation and which magnet only permits the closure of these contacts when current is not flowing through the tabulator circuit. In addition to this control effective operation of the reset key during tabulating operations is prevented by a tabulator driven cam 101 which keeps contacts 100ª and 102 open except at the end of the tabulator cycle, thereby preventing the taking of a total until the tabulator has finished tabulating items from a run of cards.

After starting, the reset key may be released since control of the circuit to the clutch magnet 62 and to the total printing and resetting motor 60 is taken over by cam contact devices 125—125ª and 126—126ª which are actuated by a shaft 90 in the printing attachment (see Fig. 4). These contacts 125ª—126ª also control the making and breaking of the circuits 221 to the various printing magnets 38 in total taking operations. The control of these contacts over these circuits is such as to only supply current to the circuits when a printed total is to be taken. Circuits 221 extend to contacts 85 and a detailed explanation of the taking of a printed total by these contact devices will be given hereafter.

The reset motor by its rotation is adapted to first effect the printing of a total or totals and thereafter it may reset one or more of the tabulator counters to zero if the parts are adjusted for resetting. Referring to Fig. 3, the shaft of motor 60 carries a worm wheel 61 that imparts rotation to a gear wheel 67 loose upon shaft 90. The closure of the reset motor circuit by key 58, or by the automatic means to be hereafter described, energizes an electromagnet 62 which releases a clutch 63 on the shaft 90 by the movement of its armature 64, rigid with an arm 65 that raises a pin 66 out of a circumferential groove in the clutch and permits the said clutch which is keyed to shaft 90 to engage under spring action with the wheel 67.

The said arm 65 carries also a pin 68, see Figs. 4 and 12, and on its upward movement causes said pin 68 to engage with pawl 69 engaging with a notch in a cam 70 on a shaft 71 (see also Fig. 2). The pawl 69 is carried by an arm or plate 72 which is fixed to a gear wheel 73 (Fig. 13) loose on shaft 71, and in gear with the shaft 90 through a gear wheel 75 (Fig. 12), but as the pawl is thus disengaged from the cam 70 the latter is not revolved by the first revolution of the pawl 69 and gear 73. The magnet 62, however, as shown diagrammatically in Fig. 36, is short circuited by a properly timed cam 74 with cooperating contacts 127 so that the control of the reset motor is taken away from cam contact devices 125, 125ª, 126, 126ª. During the time the cam 74 has closed contacts 127 current flow to magnet 62 is prevented but current is allowed to continue to flow to motor 60 as will be understood from the diagram. When magnet 62 is short circuited, a pin 68 drops out of the path of the pawl 69 during the first revolution of gear 73, which pawl is thereby permitted to re-engage with the cam 70 and to rotate the same during and by the second rotation of the gear wheel 73. By the above described arrangement the gear 75, makes one revolution while the gear 73 makes two. The purpose of this may be thus explained.

During the first half revolution of the gear wheel 75, the lever 27 operates to raise the type carrier and print a total or totals, but during this period the gear wheel 73 is rotating, whereas cam 70, pinned to the shaft 71, is stationary. During the second half of the revolution of wheel 75, however, while resetting the type carrier, the gear 73 rotates and picking up the cam 70 imparts its rotation to the shaft 71 which operates in the usual way to reset such tabulator counters as are selected for resetting to zero. Resetting devices for tabulators are shown in Hollerith Patent 1,030,304, dated June 25, 1912.

Fixed to the gear wheel 75 is a cam 76 best shown in dotted lines in Fig. 12, and upon this cam bears an arm or lever 77 pivoted at 78, see Fig. 15. The lever 77 is connected by a turn buckle 79 with an arm 80 fixed to a shaft 81, which extends back through the tabulator counters, where over each set of indicating wheels 82, Figs. 17 and 18, it

carries a bail 83 fast to it, and associated, as will be set forth, with contacts corresponding to each indicating wheel.

In gear with the indicating wheels and moving in exact unison therewith are cam disks 84 (Fig. 20) with ten steps of varying height corresponding to the numbers on the wheels; that is to say, the highest step corresponding to 9 and the lowest to zero. By each rotation of the cam 76 the shaft 81 is rocked and the bail 83 is depressed, and this results in the following operation.

A set of contacts 85, 86 are associated and mounted with suitable insulation on a support 87 turning loosely on shaft 81, and by a spiral spring 88 the lower contact 85 is held against a shoulder on an insulating post 89 on bail 83, while the upper contact 86 is held out of contact with 85 by the top of this post which projects up through the lower contact. When the bail 83 is lowered an insulating stop on each contact 85 comes in contact with that step on the disk 84 under it, which on the stoppage of the machine is presented to that position, so that the bail still descending draws the post 89 away from the upper contact and allows this to come into engagement with the contact under it.

It will be borne in mind that when the conditions now being described are established by the depression of the key 58, or by the closure of contact 105—102, the last figure or figures in the column in the listing machine have been printed and the type-carriers restored to their initial or normal positions. But, while such type bars or carriers, after the operation of key 58, are not raised again by the movement of lever 12, they are raised in the same way by the lever 27 and move in a synchronism with the bail 83 and its associated parts. Hence, when this bail is depressed and the circuit controlling contacts 85 and 86 brought into operation, these contacts will close at points in the cycle of operation dependent upon the height of the steps on disks 84 which they encounter, or in other words, the value of the digits which these steps represent.

The contacts 85, 86 control the circuits of the magnets 38 when printing totals, and hence these magnets will arrest the type carriers at points in which the type thereon corresponding to the steps are brought into the printing position. It will be seen that in this machine there is one set of type for each column of figures which are used for both listing and total printing. These type are arranged in vertical rows with the 9 at the top of the carrier. This is so that the type will correspond with the numbers when listing, as the 9 is the first number which on a perforated card comes under the tabulator contact brush when the cards are fed through the machine. In taking a total the step cam disks 84 have the highest points to represent 9 so that when the contact device is locked down on these disks, the first point of contact would of course, be the highest point, representing 9.

Referring to Fig. 17 and the diagram, Fig. 33, above contacts 86 are supplementary contacts 86^a which with contacts 86 establish the circuits between the printing magnets 38 and the plugboard sockets when the machine is to be used for listing. Upon taking of the total, these circuits to the plugboard are interrupted by opening of contacts 86—86^a which is brought about by downward rocking of bail 83 at this time. In this way, back flow of current through the plugboard and brushes and counter magnets is prevented during total taking operations.

The method of automatically taking a printed total and resetting the tabulator counters will now be described. It will be assumed that a group of cards has passed through the tabulator and that the items are accumulated upon the counters and the tabulator stopped at the end of the card group by the stop card, the card lever 100, cam contact 99 and 96 in the manner previously described. If automatic total printing and resetting is desired, the manual auto-print and reset switch 106 is first closed. Then, as the tabulator comes to a stop, cam 101 which is disposed upon a shaft 220 of the tabulator (see Fig. 33) closes contacts 105, 102. The closure of these contacts establishes the circuit to the total printing and resetting motor 60 and initiates the printing and reset cycle which is now completed in the manner explained for a manual taking of the total.

Under certain conditions, it is desirable that tabulating be automatically recommenced at the termination of the printing and reset cycle provided there are cards in the machine available for further tabulating operations. For example it may be assumed that a group of cards of a predetermined group has passed through the machine, the items tabulated, the operation interrupted, and a total taken either manually or automatically. Then if there are cards of a different group available for further tabulating it may be desirable to automatically recommence tabulating upon the second group. In connection with such an operation, it is also desirable to prevent tabulating during total printing or resetting operations, otherwise a confused and improper tabulation or accumulation would be performed.

To secure such control, cam contact devices 128—129—154 are provided. Cam 154 is disposed upon a shaft 90 in the printing attachment and at the end of the printing cycle effects a closure of upper contacts 128 and thereby initiates a new tabulator cycle provided the manual autostart switch 130

be closed and relay magnet 131 be energized. As previously explained, relay magnet 131 is in circuit with the card lever 100, and this circuit will be interrupted when there are no cards in the machine. Therefore the tabulator cannot be restarted if the cards are exhausted. If, on the other hand, the tabulator has been stopped by a stop card the interruption of the circuit to relay 131 is only temporary, since the notch in the stop card will have passed the card lever 100 permitting the reclosure of the circuit to relay magnet 131. If this circuit is closed the tabulator motor circuit can be closed through relay 150, relay 131, switch 130 and cam contact devices 128 upon the rotation of cam 154. After the tabulating operation is thus initiated, control of the tabulator motor circuit is taken over by magnet 151, cam contact devices 96, 96ª and 99, the stop card lever 100 in the manner previously explained so that the tabulating will continue until the passage of the next stop card or after the passage of the last card beyond card lever 100.

Cam contact devices 154—129 serve to prevent tabulating during the printing and resetting operations by opening lower contacts 129 and maintaining said contacts open until the printing and resetting operation is complete (see Fig. 26). When such contacts are open, the operation of the start key 57 is ineffective to initiate a tabulating operation.

The relay magnet 153 in the card lever circuit serves to control the circuits to the brushes and counter magnets and prevents adding or listing when there are no cards in the machine.

In the foregoing reference has been made particularly to the diagram Fig. 36. The various cam contact devices described as being driven by the tabulator shaft 220 are shown in Figs. 29 to 33 inclusive. These comprise cam contacts 96ª, 97, 97ª, 98, 98ª, 101, 102, 105 and 100ª, 99, 200, 204 and 201. These cams and contact devices are located in a box 95, Figs. 1—27—28 and the driving cams are all mounted upon a shaft 220 which is geared to rotate in unison with the tabulator driving shafting.

Cam contacts 125, 125ª, 126, 126ª, 74—127, 154—128—129, are all actuated by a shaft 90 in the printing attachment. These contact devices are actuated whenever shaft 90 is connected up to and rotated by motor 60. The cam contact assembly which is driven by the printer is best shown in Fig. 21, see also Fig. 5. The individual cam and contact devices are shown separately in Figs. 23 to 26 inclusive.

There are three switches 139, 107 and 108, shown in Figs. 1 and 36, which control the three printers of the counters 4, 5 and 6 respectively. If these switches are opened the circuits to the corresponding ten printing magnets 38 of each set which control the stopping of the type bars or carriers, are broken, and the type carriers will all travel to present a blank point in the printing position so that no figures will be printed.

In Figs. 34 and 35 the details of the clutch control magnet 104 which controls the starting and stopping of the tabulator are shown. The circuit of this magnet is controlled primarily, either manually by the tabulator start key 57, or automatically by the cam contact devices 154—128, and when this magnet is thus energized it attracts its armature 109, thereby disengaging a pin 110 mounted on lever 111 rigid therewith, from the sliding clutch member 112 impelled by spring 113 and this member when so released is forced into engagement with the tabulator shaft thereby starting the tabulator. The armature 109 remains in attracted position as long as the tabulator is running and until the cam contacts 96, 96ª break the circuit after the passage of the last card or stop card, when the magnet 104 releases the said armature which is then forced away from the magnet cores by means of a spring plunger 114. As the pin 110 engages in a slot in the clutch member 112 a properly tapered portion of this slot throws out the clutch when engaged by the pin 110. Contacts 103 are broken while magnet 104 is energized, this being effected by an arm 115, carried by the lever 111.

In Fig. 16 is shown the inking ribbon feed, the construction of which may be any known in the art, and which is not described herein in detail as it forms no part of the present invention. This ribbon feed is operated by a pin 116, extending from the cross-head 30, see Fig. 3, and engaging in a slot in a pivoted bar or plate 117. As the cross-head rises and falls this engagement imparts a sufficient sidewise movement to the bar 117 to feed the ribbon one step.

In Fig. 3 a push button 118 is shown which when hand-operated releases a clutch member 63 in the printing mechanism whenever it may be desired to operate the machine by hand.

In Figs. 3, 8 and 8ª a zero control device 120 is shown. There is one of these levers for each type carrier and each is pivoted at 121. Each lever has an arm 122 projecting over the next lever to the left of the group of nine levers. If the lower ends of lever 120 drop into a recess or slot 123 in the bars 33 these bars will rise to a point where a blank space is presented to the printing position; but should the levers 120 be held out so that the ends do not pass into the recesses 123 but are stopped by a projection 124, then the type carriers will be raised to a point where they present zero type at the printing position. From the construction

shown and described it is manifest that all type carriers to the left of those thus raised to print zero will present blank spaces at the printing position, so that no zeros will be printed at the left of a total or listed item.

In Figs. 21 and 22 there is shown a cam mechanism which is used for boosting the shaft 90 forward to complete the cycle, and thus overcome the additional load thrown on that shaft at the end of each cycle. This mechanism comprises a lever 132 pivoted at 133 and having a right-angled arm 134 to which is connected a stout spiral spring 135. The lever 132 carries a roller 136, which travels over the high part of a cam 137 on the shaft 90, and by this means the spring is held under tension. Near the end of the cycle the roller drops into a depression over the inclined surface 138 and the force of the spring is exerted against this inclined surface with a tendency to push the cam and shaft in the direction of its normal movement.

The tabulator, as will be seen from Figs. 1 and 13, is provided with hand-operated milled sleeves 140 on the shaft 71, for throwing in the clutch members 141 that operate to throw into operative condition the means for resetting of the tabulator counters. The sleeves 140 are of any ordinary construction and contain indentations into which pins or clutch members 141 pass when the sleeves are forced forward, and when they are thus set or forced in the corresponding counter will reset to zero. On the milled sleeves 140 are grooves 142 into which project the ends of pivoted levers 143, see Figs. 1 and 2, so that as the sleeve is moved in or out of engagement this lever operates the contacts 144 as shown in Fig. 17. One of the type carriers 33, which in Fig. 9 is marked 145, has but two type, an asterisk, and the letter S, and this carrier is controlled in its upward movement by the same means as the other type carriers.

When contacts 144 therefore are broken the carrier 145 is permitted to rise until the asterisk is brought to the printing position and is printed together with the total. This indicates that when the total was taken, that tabulator counter was reset to zero.

On the other hand, if the clutch member 141 is out, the lever 143 is in a position to close contacts 144 and if a total be taken with these contacts closed and the clutch out, the counters are not reset, and the type carrier 145 is stopped to present the S to the printing position, which will indicate that the total is a subtotal and that the counters were not reset. The S type carrier is controlled by magnets similar to 38 and the circuits to these are closed at the proper time by contacts 144, 146 and 147 as will be presently described.

In addition to the contacts 144 for controlling the printing of the asterisk and the S there are two contacts 146 and 147 shown in Fig. 36 though but one appears in Fig. 17 as the other is on the other side of the counter. When a total is taken by the depression of the bail 83 an insulated screw 148 brings contacts 146 first together and a similar screw brings contacts 147 later together. If contacts 144 happen to be closed by the clutch member 141 being out, then the type carriers are stopped at the position to print S, but if contacts 144 are opened and switch member 141 in, when contacts 146 close, the S is passed and when later, contacts 147 are closed the carrier is stopped to print an asterisk.

By the use of the subtotal device herein described I may obtain so-called accumulated subtotals. If the counter is not reset, each successive subtotal will show not only the items of a particularly listed group, but will also include the amounts of the subtotals previously printed. This result is desirable where it is desired to show the subtotal on the bottom of one record sheet and to carry the same amount and repeat the printing on the top of the next sheet. Thereafter further amounts may be accumulated and other accumulated subtotals taken. Furthermore by resetting the counter or counters after the taking of each subtotal, true non-accumulated individual subtotals can be secured. It is also possible to print a grand total in a separate column representing the total of the various subtotals in a different column.

It is to be understood that the printing of totals or subtotals may be effected after a listing of a run of cards or after straight tabulating operations when no listing is being carried out. It is only necessary to shift the listing lever 17 and speed change lever 48 to the proper position to selectively control whether the machine is to list and tabulate or to tabulate without listing. Total or subtotal printing may be carried out and controlled in either case in the manner heretofore described.

In the diagram Fig. 36 I have shown separate wires from the plugboard to the counter magnets and to the printing or listing magnets and also a plurality of plug sockets connected to the individual contact blocks 93^a. This arrangement permits the counters alone, or the printer or listing magnets alone, or a combination of both printing listing and counter magnets to be connected up to the card controlled brushes. Thus by a selection of proper plug connections I am enabled to carry out on one machine straight tabulating without either printing or listing, straight printing or listing without tabulating or combined tabulating and printing and listing.

By the use of the plugboard in the manner heretofore used in nonprinting and nonlisting tabulators, I am enabled also to list upon one column of the record sheet and take subtotals in said column. The amounts thus listed in one column may likewise be tabulated on a separate column which is not connected up for item listing. Then at the end of a run of cards I can however take a grand total from this separate counter and print the result in a corresponding separate column upon the record sheet. In this manner listing and subtotaling operations can be printed in one column and grand totals taken and printed in another. The number of separate columns to be tabulated or listed and the numbers of counters and printed sections to be utilized may be varied widely by the proper use of the plug connections between the contact blocks 93ª which are connected to the brushes and the counter relays and the printing magnets.

Referring again to the diagram Fig. 36, the switch 222 when closed cuts out the group indicator 223 and when open brings this group indicator into operation. The group indicator is fully described in Hollerith Patent 1,087,061. The purpose of this device is to cut out registrations on a counter after the first card of any group has passed the brushes. In this way, group designating numerals are set up upon the counter. By using this device in connection with my printing attachment, I am able not only to visually indicate the group numbers but also to print them upon the record sheet. For straight tabulating when it is desired to accumulate items on the group indicator counter with or without listing them, switch 222 is closed but in group indicating and group printing operations when this particular counter is used to set up the group designating character of the first card, it is open.

By utilizing the group indicator device in connection with the printing attachment I am able to print the group number along with the printed totals when the machine is not set for listing. Or I may list and repeat the printing of the group number for each item when listing items. In this operation the adding plugs to the group indicator counter are disconnected and the listing plugs only are connected, and therefore group printing is not effected during total-taking. Also, by disconnecting the listing plugs and connecting the adding plugs to the group indicator counter I may set up the group number therein when the first card passes the brushes and when a total is printed this group number will be printed. In this case no group numbers will be printed alongside the listed items.

There are other mechanical parts and details used in the apparatus above described which require no specific description that will tend to convey a more complete understanding of the main invention, or which are present in other machines of this general class and are well known. In the above description attention has been paid to the more or less specific construction of the purely mechanical elements and reliance has been had on the diagram, Fig. 36, for the electrical devices as the functions of these and not their specific construction are of the essence of the invention.

The tabulating art has reached a well known stage of development where with the information herein contained any skilled worker in this art will be able to add to such a machine the novel features of this invention—a listing and printing attachment—so coordinated with the tabulating mechanism that it may be utilized at the will of the operator to list the figures set up on the counters by the perforated cards, to take subtotals and totals and to reset the tabulator counters. No machine so far as I am aware, has heretofore been produced that will effect these operations in the manner herein set forth.

What I claim as my invention is—

1. The combination with a tabulating machine of a printing or listing attachment, intermediate mechanism for connecting it with or disconnecting it from the tabulator mechanism and means for causing the tabulator to run at reduced speed under the control of the means which connect the listing attachment with said tabulator.

2. The combination with a power driven tabulating machine of a printing or listing attachment, intermediate mechanism for connecting the same with or disconnecting it from the tabulator mechanism, and means for applying the driving power to the tabulator at varying rates, operatively controlled by said intermediate mechanism whereby the machine will be run at a reduced speed when the printing and listing attachment is connected with the tabulator mechanism.

3. The combination with a tabulating machine of a printing or listing attachment, intermediate mechanism for connecting the same with or disconnecting it from the tabulator mechanism, and means controlled by the listing attachment to prevent the tabulator from operating while said attachment is in operation for the printing or listing.

4. The combination with a tabulating machine of a printing or listing attachment, intermediate mechanism for connecting the same with or disconnecting it from the tabulator mechanism, and means for resetting the tabulator counter wheels to zero operated by and during the operation of the total printing means in said listing attachment.

5. The combination with a tabulating machine of a printing or listing attachment, intermediate mechanism for connecting the same with the tabulator mechanism or disconnecting it therefrom, and mechanism in said attachment controlled by the tabulator counter wheels, and adapted to operate independently of the listing means for printing the totals indicated by the adjusted position of the tabulator counter wheels.

6. The combination with a tabulating machine of a printing or listing attachment, means for connecting it when desired with the tabulator mechanism whereby it lists the figures perforated in the tabulating cards, means in said attachment cooperating with the tabulator mechanism for printing the totals displayed by the counters, means controlled by the total printing mechanism for resetting the tabulator counters to zero, and means for indicating when such resetting mechanism has been brought into operation and when not.

7. The combination with a tabulating machine of a printing or listing attachment and means for bringing the same into operative relation with the tabulator mechanism, and circuit controlling means in both the tabulator and the listing mechanism for automatically and cooperatively controlling the operations of both mechanisms.

8. The combination with a tabulating machine of a printing or listing attachment and means for operatively connecting the same with the tabulator mechanism, movable type carriers in the said attachment operated in unison with the tabulator mechanism, and electromagnets operated by the tabulator contact brushes for stopping at the printing position the type in such carriers that represent the perforations in the tabulator cards through which such brushes make contact.

9. The combination with a tabulating machine of a printing or listing attachment and means for operatively connecting the same with the tabulator mechanism, means for controlling the speed of the tabulator and interconnecting circuits between the tabulator and its attachment and circuit controllers therefor which prevent the tabulator from being operated at its normal or high speed when the listing attachment is connected therewith.

10. The combination with a tabulating machine of a printing or listing attachment and means for operatively connecting the same when so desired with the tabulator mechanism, means for controlling the speed of the tabulator, interconnecting circuits between the tabulator and its attachment and circuit controllers, both manual and automatic, therefor which prevent the tabulator from being operated at its normal or high speed while the listing attachment is connected therewith.

11. The combination with a tabulating machine having sets of counter wheels, of a printing or listing attachment having corresponding sets of printing devices, means for operatively connecting said attachment with the tabulator mechanism, and means for connecting up the resetting mechanisms for the tabulator counters with the total printing mechanism of the attachment.

12. The combination with a tabulating machine and a printing or listing attachment adapted to be brought into operative relation therewith, of motors in both the tabulator and in the attachment, means for connecting the tabulator and listing mechanisms and means for bringing the motor in the attachment into operation for printing totals and for resetting the tabulator counters to zero.

13. The combination with a tabulating machine of an attachment therefor comprising means for listing the figures perforated in the tabulating cards at each cycle of operation of the tabulator while adding on the tabulator counters, and means for printing the total displayed at any time by such counters, contacts operated by said printing means and operating upon cams on the tabulator counter wheels to control the operation of the total printing mechanism.

14. The combination with a tabulating machine of a printing or listing attachment comprising mechanism for listing figures corresponding to those added at or by each cycle of the operation of the tabulator, and independent means for printing the totals displayed at any time by the tabulator counter wheels, means normally connecting the listing mechanism with the tabulator mechanism and total printing controlling means adapted on its operation to disconnect said mechanisms.

15. In a card-controlled tabulating machine, in combination, automatic registering mechanism controlled by record cards, total-taking mechanism, selective devices having provisions for determining whether the operation of the total-taking mechanism shall be initiated manually or automatically, and selecting devices having provisions for determining whether the resumption of registering operation after a total-taking operation will be initiated automatically or manually.

16. The invention set forth in claim 15 in which means is provided for selectively controlling whether the registering devices are to be reset after a total-taking operation or allowed to continue accumulating without resetting.

17. In a card-controlled tabulating machine, in combination, automatic registering mechanism controlled by record cards, total-taking mechanism therefor, and selective devices having provisions for selectively pre-

determining whether the registering mechanism will be reset after a total-taking operation or permitted to continue accumulating without resetting.

18. In a card-controlled tabulating machine, in combination, automatic registering mechanism controlled by record cards, total-taking mechanism therefor, and selective devices having provisions for selectively determining whether the registering devices will be reset automatically after a total-taking operation or whether the resetting will be initiated by a manual operation.

19. In a machine of the class described, in combination, card-controlled registering tabulating devices, total-taking mechanism therefor, means for operating the same, and circuit control means for determining whether the operation of the total-taking mechanism shall be automatically or manually initiated.

20. In a machine of the class described, in combination, a tabulating machine, a printing attachment having type carriers provided with type for printing totals, means for suppressing the operation of said type carriers during tabulating operations, means in the tabulating machine for interrupting the tabulating operation upon the completion of the tabulating of a group of cards, automatically operable means in the said tabulating machine for bringing the printing attachment into cooperative relation with the tabulator to effect total printing of the tabulated items, and automatically operable means for thereafter restarting the tabulating operation upon the succeeding card group.

21. The invention set forth in claim 20 in which means is provided for automatically resetting the tabulator to zero upon the completion of taking of a printed total.

22. In a machine of the class described, in combination, a tabulating machine, a printing attachment, card-controlled means in the tabulating machine for automatically interrupting the tabulating operations, means operable automatically upon such interruption of tabulating for effecting total printing by the printing attachment of the items tabulated without restarting the tabulator, and manually operable means for restarting the tabulator in the tabulating operation upon additional cards.

23. The invention set forth in claim 22 in which means is provided for automatically resetting the tabulator to zero after printing is completed and prior to the restarting of the tabulator.

24. The invention set forth in claim 22 in which manually controlled means is provided for initiating the resetting of the tabulator to zero upon the completion of the total printing operation.

25. In a machine of the class described, in combination, a tabulating machine, a printing attachment, means for preventing the operation of said attachment during tabulating operations, card-controlled means for interrupting the tabulating operation, manually operable means for bringing the printing attachment into cooperative relation with the tabulator to effect total printing of card data accumulated thereby, and automatically operable means for restarting tabulating after the total printing operation.

26. The invention set forth in claim 25 in which means is provided for automatically resetting the tabulator to zero after the total printing is completed and prior to the restarting of the tabulator.

27. In a machine of the class described, in combination, a tabulating machine, a printing attachment therefor, card-controlled means for interrupting the tabulating operation upon predetermined conditions, manually operable means for bringing the printing attachment into cooperative relation with the tabulator to effect total printing of the card data accumulated thereby, and independent manually operable means for thereafter restarting the tabulator in its tabulating operation upon a succeeding set of cards.

28. The invention set forth in claim 27 in which means is provided for resetting the tabulator to zero upon the completion of the printing operation.

29. In a machine of the class described, in combination, a tabulating machine, a printing attachment therefor, means for bringing the attachment into cooperative relation with the tabulating machine to print a total of the numbers set up therein, and means operable by the tabulator for preventing the operation of the printing attachment when the machine is tabulating cards.

30. In a machine of the class described, in combination, a tabulating machine, a printing attachment therefor, means for bringing the attachment into cooperative relation with the tabulating machine to effect total printing of the desired items in the tabulator, and means operable by said printing attachment for preventing the operation of the tabulator when such total printing is being effected.

31. The invention set forth in claim 30 in which means is provided for preventing effective operation of the total printing attachment to print totals when the tabulating machine is operating successively upon cards.

32. In a card controlled tabulating machine, in combination, automatic registering mechanism controlled by record cards, total-taking mechanism therefor, said mechanism having devices coacting with the registering mechanism to take a total therefrom prior to

the resetting of said registering mechanism, and means including a device brought into operation automatically by the operation of the tabulating machine for resetting the registering mechanism after a total is taken therefrom by the aforesaid total-taking mechanism and devices.

33. In a perforated card controlled mechanism, in combination, electrically controlled tabulating means for accumulating items from record cards, means for taking printed records of subtotals of said items, and means for taking a printed grand total of all of said subtotals.

34. In a perforated card controlled mechanism, in combination, electrically controlled tabulating means, for accumulating items from cards upon registering devices, means for taking a printed record of a total of items accumulated, means for thereafter resetting the registering devices to zero, and means for thereafter accumulating a second total and taking a printed record thereof.

35. In a card controlled mechanism, a tabulator adapted to accumulate items from record cards, a printing attachment for printing totals having provisions for suppressing the listing of items making up said totals, and means controlled by said tabulating machine for printing the designating group numbers with said totals.

36. In a card controlled mechanism including in combination, a tabulator adapted to accumulate items from records cards, a printing attachment for listing items and printing totals of a plurality of items accumulated upon said tabulator, means for printing non-accumulated group indicating numbers correlated with the first listed item of a group and with the printed total of that group, and means for suppressing the printing of such group indicating numbers with the intermediate items which are printed after the first item printing and until a total of the group is printed, said item printing means being controlled by the tabulator and in accordance with the group numbers of cards which are tabulated thereby.

37. In a card controlled mechanism, in combination, a tabulator for accumulating certain items from the cards and visually indicating the group designating characteristics thereof, and a printing attachment for listing the successive items accumulated from the cards by said tabulator and for also printing the non-accumulated group designating characteristics of the passing cards.

38. In a card controlled mechanism, in combination, an electrically controlled tabulator for accumulating certain items from the cards, means controlled by said tabulator for imprinting upon a record sheet totals of items accumulated by said tabulator and concurrently imprinting group numbers of non-accumulated items.

39. In a card controlled mechanism, in combination, an electrically controlled tabulator provided with brush contact devices adapted to accumulate items from record cards, a printing attachment with provisions for listing the items of the accumulation and for printing the total thereof, and means in said attachment for printing with each item a group designating number and for suppressing the printing of said group number in printing a total.

40. In a card controlled accounting machine, in combination, a tabulating device for accumulating items from cards, a printing attachment, means therein for listing successive items from said cards upon one column of a record sheet, means for concurrently accumulating the items thus listed and for printing a total of the accumulated items upon a separate record sheet column without listing the individual items thereon.

41. In a card controlled machine of the class described, in combination, a tabulating machine provided with registering devices adapted to be read visually for accumulating items from said cards, a printing attachment for printing totals of items accumulated, and means for suppressing the printing of totals when it is desired to visually read the said tabulator registering devices.

42. In a card controlled apparatus, in combination with registering mechanism for accumulating items from record cards, a printing mechanism, means for controlling the printing mechanism for listing individual items directly from the perforated record cards and independently of the registering mechanism, and means for controlling the printing mechanism from the registering mechanism when totals are to be printed.

43. In a card controlled tabulating machine, in combination, automatic registering mechanism controlled by record cards, total-taking mechanism adapted to take off amounts from said registering mechanism by means operable when said registering mechanism is at rest with a total set up thereon and automatically operable means for bringing said total-taking mechanism into operation.

44. In a card controlled accounting machine, in combination with a tabulating machine having printing devices, means in the tabulating machine for accumulating items from record cards, means for printing the individual items in one column upon a record sheet, means for printing subtotals of groups of said items in the same column of said sheet, and means for printing upon another column of said sheet grand totals of a plurality of said subtotal amounts, said last-mentioned means being adapted to suppress the printing of both the individual items and the subtotals and to solely printing

grand totals upon the other record sheet column.

45. In a perforated record card controlled apparatus, tabulating devices for accumulating one or more items from record cards, printing devices, and means for adjusting the said apparatus to perform tabulating operations without printing or listing, or to perform printing or listing without tabulating or to perform combined tabulating and printing and listing.

46. A combined tabulator and printer having accumulators to receive items from perforated records, said tabulator having provisions for performing straight tabulating without printing or listing, said tabulator having provisions for performing printing or listing operations without tabulating.

47. In a tabulating machine, means for reading perforated record cards, means controlled by said other means for printing upon a single sheet a plurality of successive items derived from such cards, means for printing a total of such items, and means for printing the totals of such items and suppressing printing of such items.

48. In a machine adapted to be controlled by perforated records, a registering device for accumulating totals of items from the perforated records, a recording device, means for operating the recording device to print a record of the amount accumulated upon said registering device, said means including take-off devices for taking off a reading from the registering device while the latter is at rest and prior to the resetting thereof.

49. In a perforated record controlled apparatus in combination, a registering device for accumulating items, a printing device, means for controlling the same independently of the registering device and directly by the perforated records to print individual items, and means controlled by the registering device for controlling the operation of the printing device for printing amounts standing on the register.

50. In a perforated record controlled apparatus, means for accumulating items from records, adjustable means for printing such items and the totals thereof on a record sheet in various groupings, and means for printing group designations with said items and totals in various relations thereto.

51. In an accounting apparatus, a set of type carriers, means for displacing said type carriers, an accumulator, means for electrically sensing the accumulator, and magnet devices controlled by said sensing means for controlling the differential displacement of the type carriers to thereby present the type corresponding to the amounts sensed from the accumulator to the printing line.

52. In an accounting machine having an accumulator, printing devices, means for operating the same, electrical means for sensing the accumulator, means for concurrently positioning the printing devices and operating the sensing devices and means controlled by the electrical sensing devices for selecting the printing devices which are to effect printing whereby the amount standing upon the accumulator and sensed by the electrical sensing devices is printed.

53. In a card controlled tabulating machine, in combination, automatic registering mechanism controlled by record cards, total-taking mechanism therefor, said mechanism having devices coacting with the registering mechanism to take a total therefrom prior to the resetting of said registering mechanism, and means including a single reset controlling element for initiating the resetting of the entire registering mechanism after a total is taken by said total-taking mechanism.

In testimony whereof I affix my signature.

CLAIR DENNISON LAKE.

Sept. 21, 1926. 1,600,413

C. D. LAKE

AUTOMATICALLY CONTROLLED PRINTING TABULATOR

Original Filed April 30, 1921 13 Sheets-Sheet 1

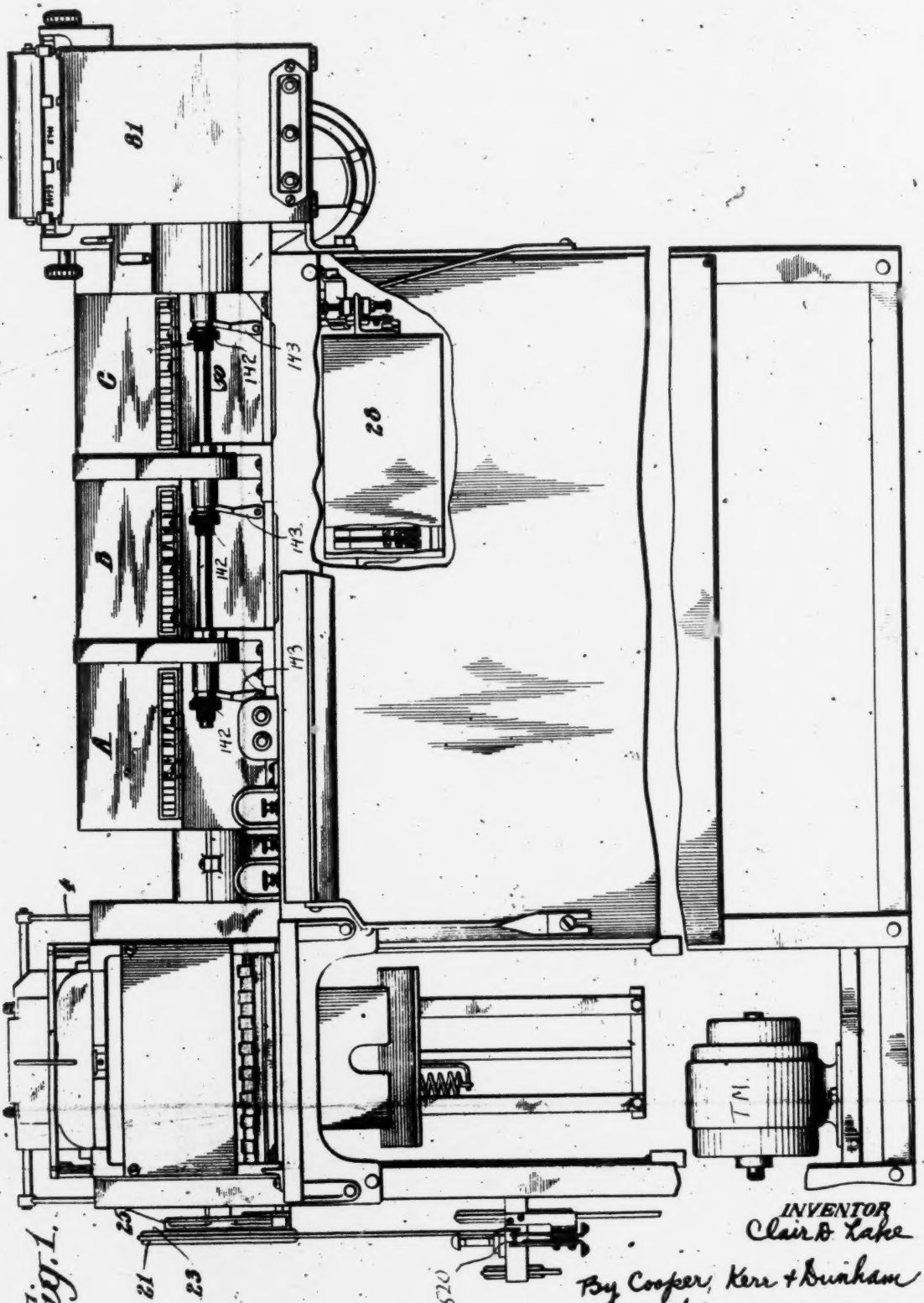

Fig. 1.

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AUTOMATICALLY CONTROLLED PRINTING TABULATOR

Original Filed April 30, 1921 13 Sheets-Sheet 2

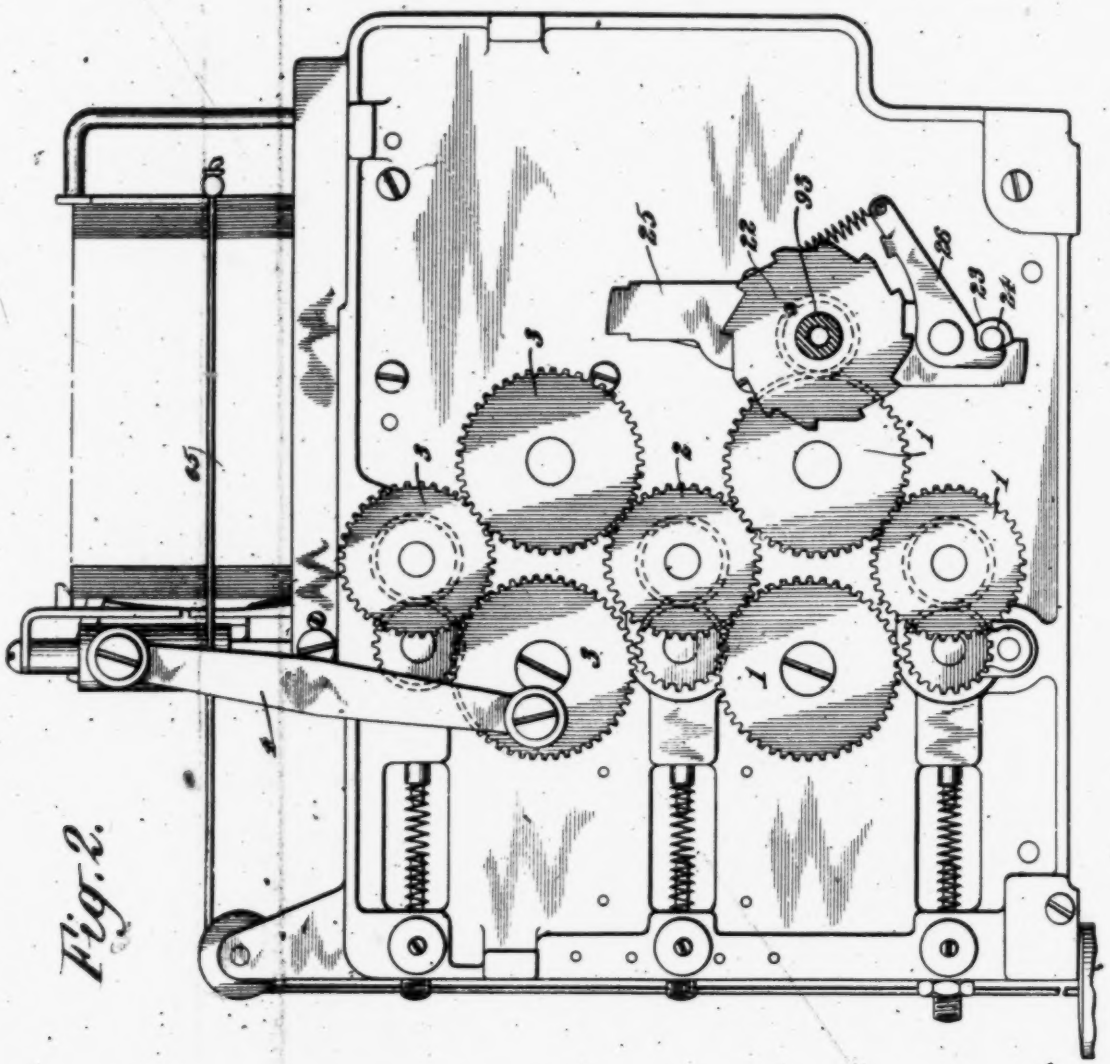

Fig. 2.

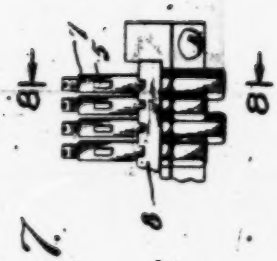

Fig. 7.

Fig. 8.

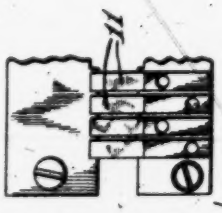

Fig. 9.

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Original Filed April 30. 1921 13 Sheets-Sheet 3

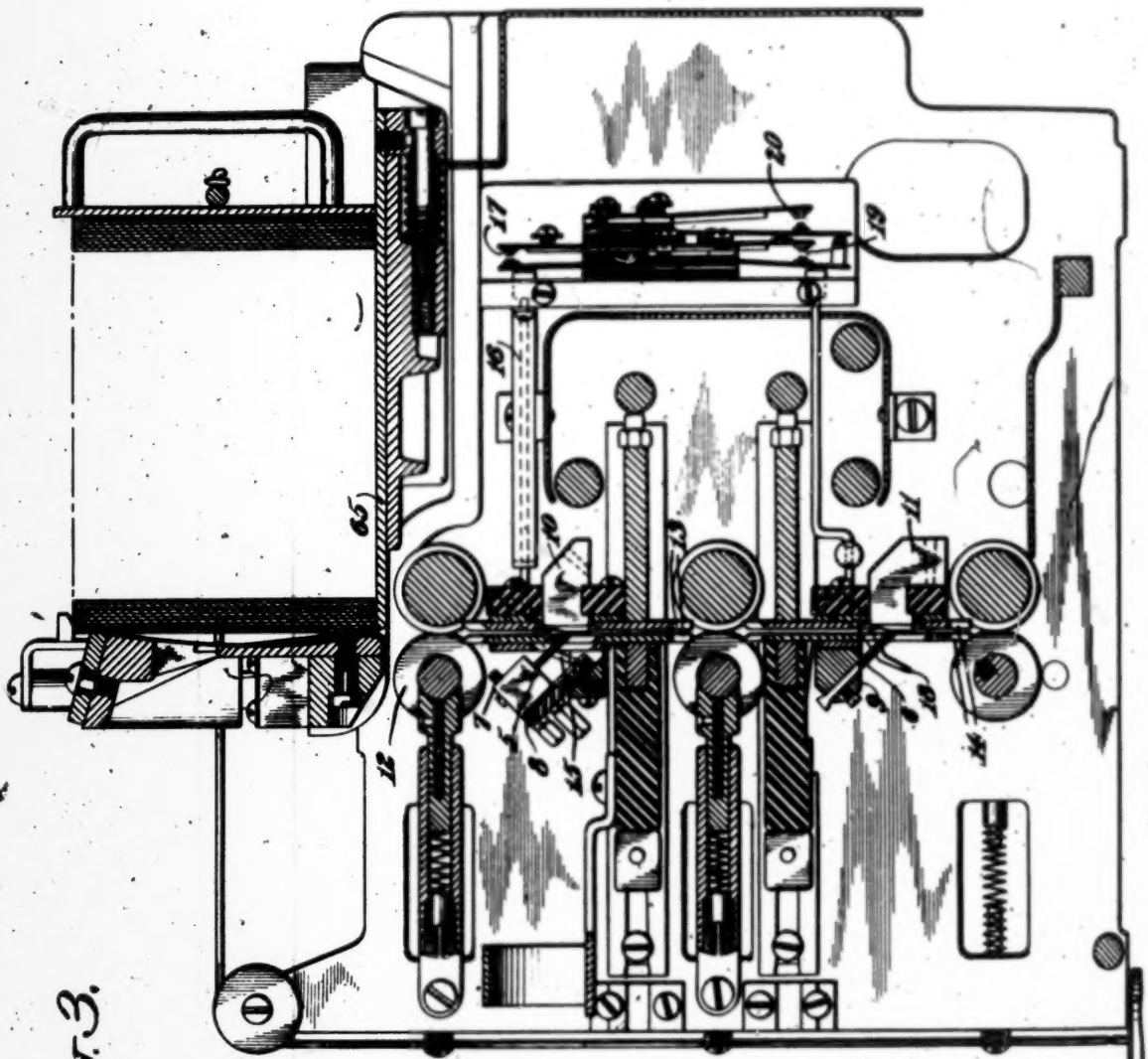

Fig. 3.

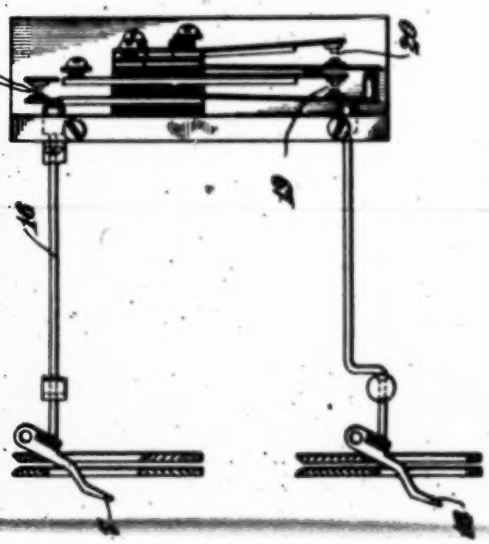

Fig. 10.

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Original Filed April 30, 1921 13 Sheets-Sheet 4

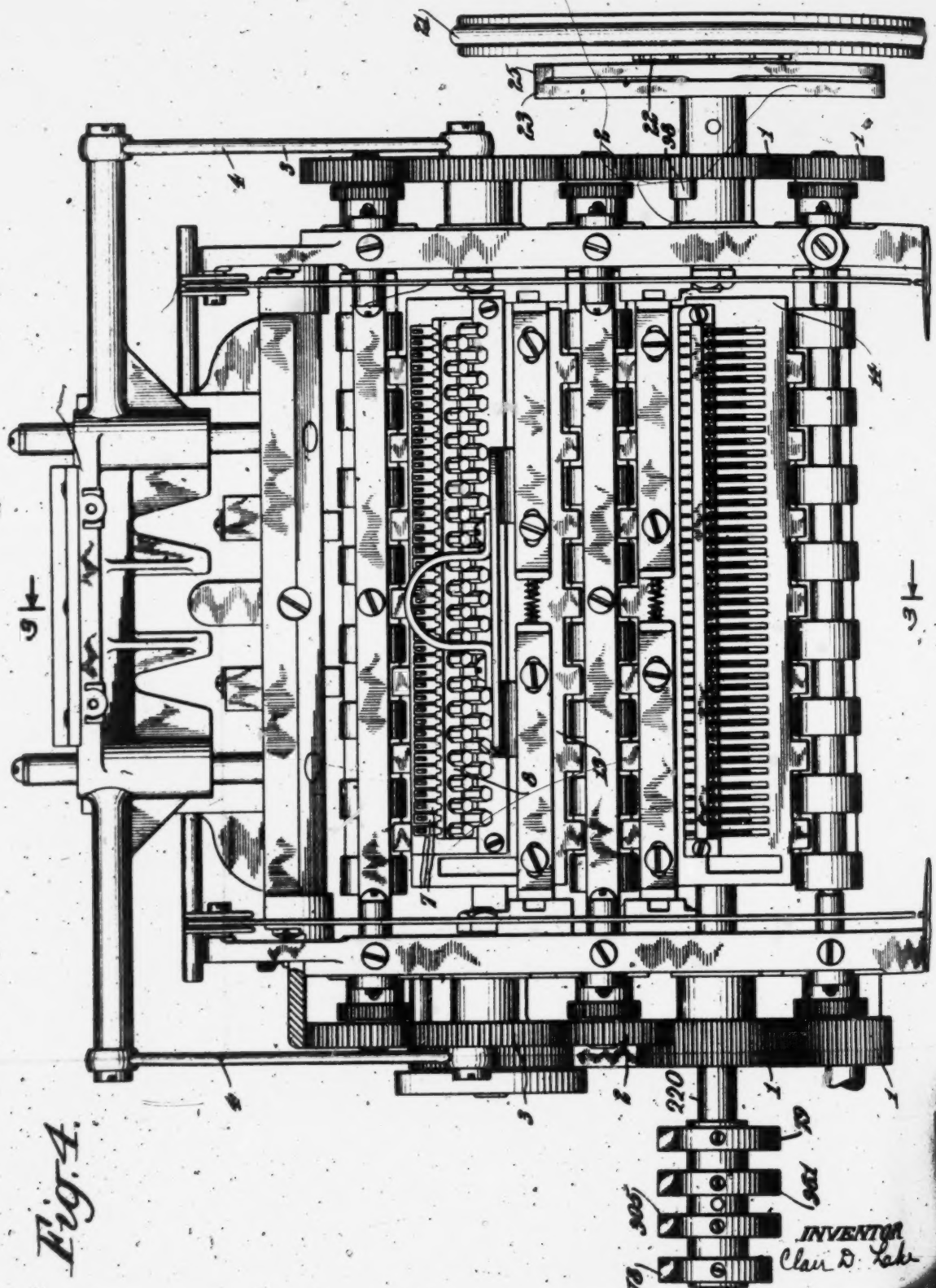

Fig. 4.

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Original Filed April 30, 1921 13 Sheets-Sheet 5

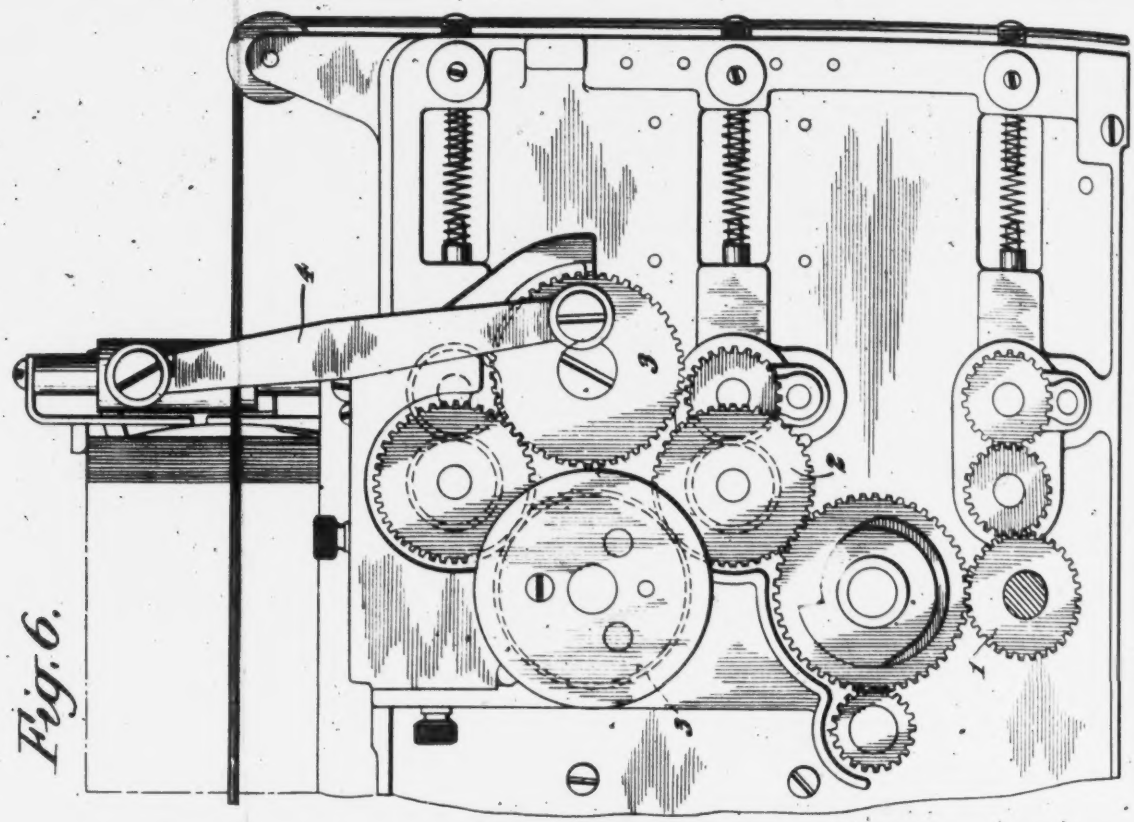

Fig. 6.

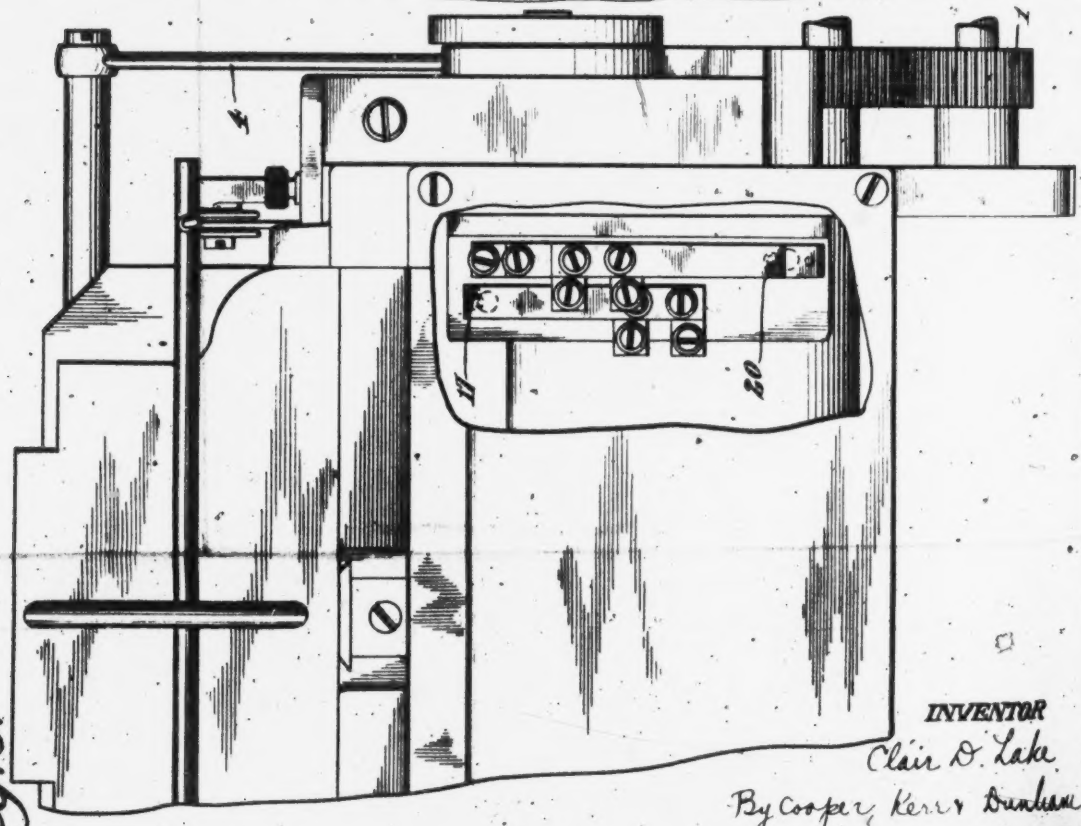

Fig. 5.

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Original Filed April 30, 1921 13 Sheets-Sheet 6

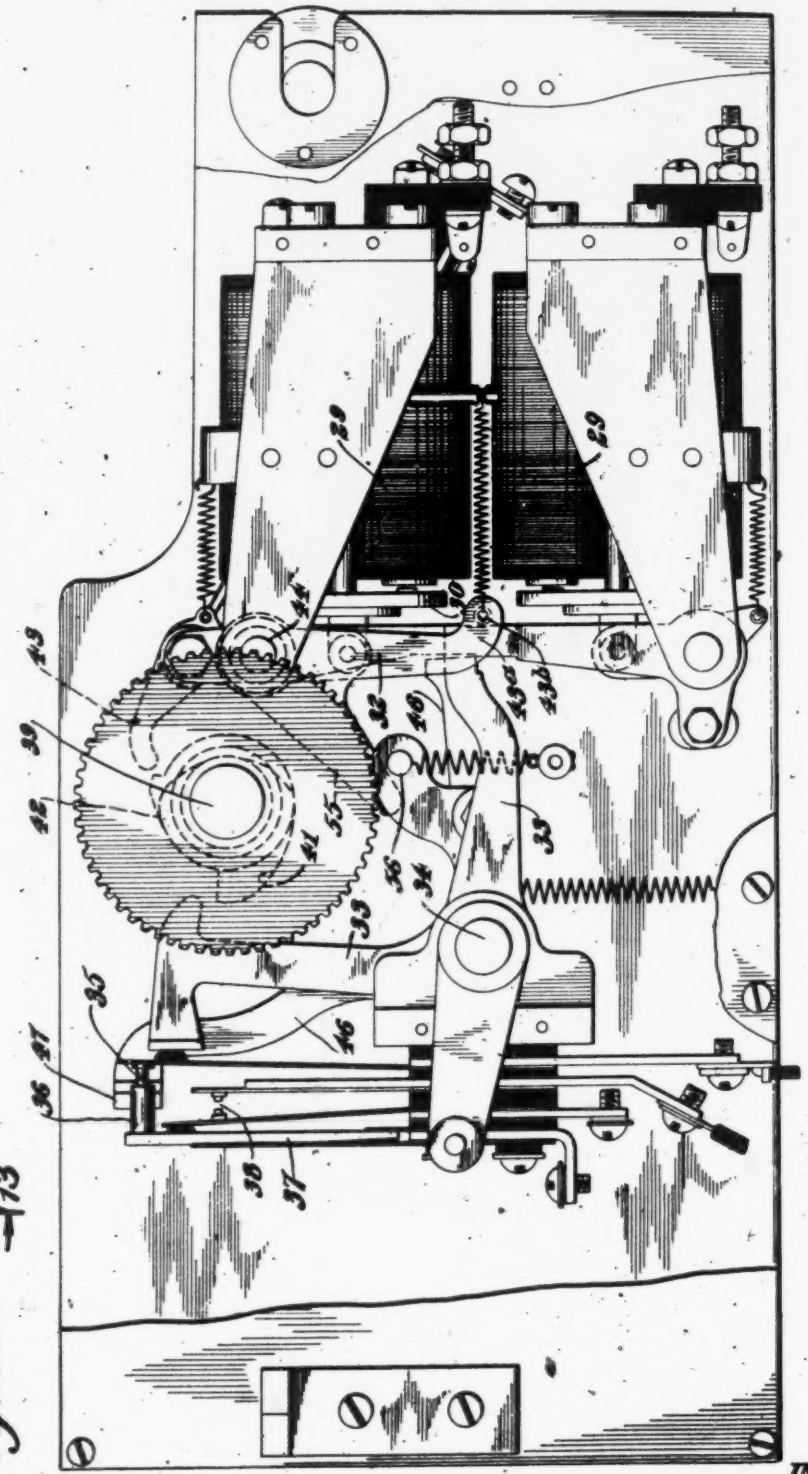

Fig. 11.

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AUTOMATICALLY CONTROLLED PRINTING TABULATOR

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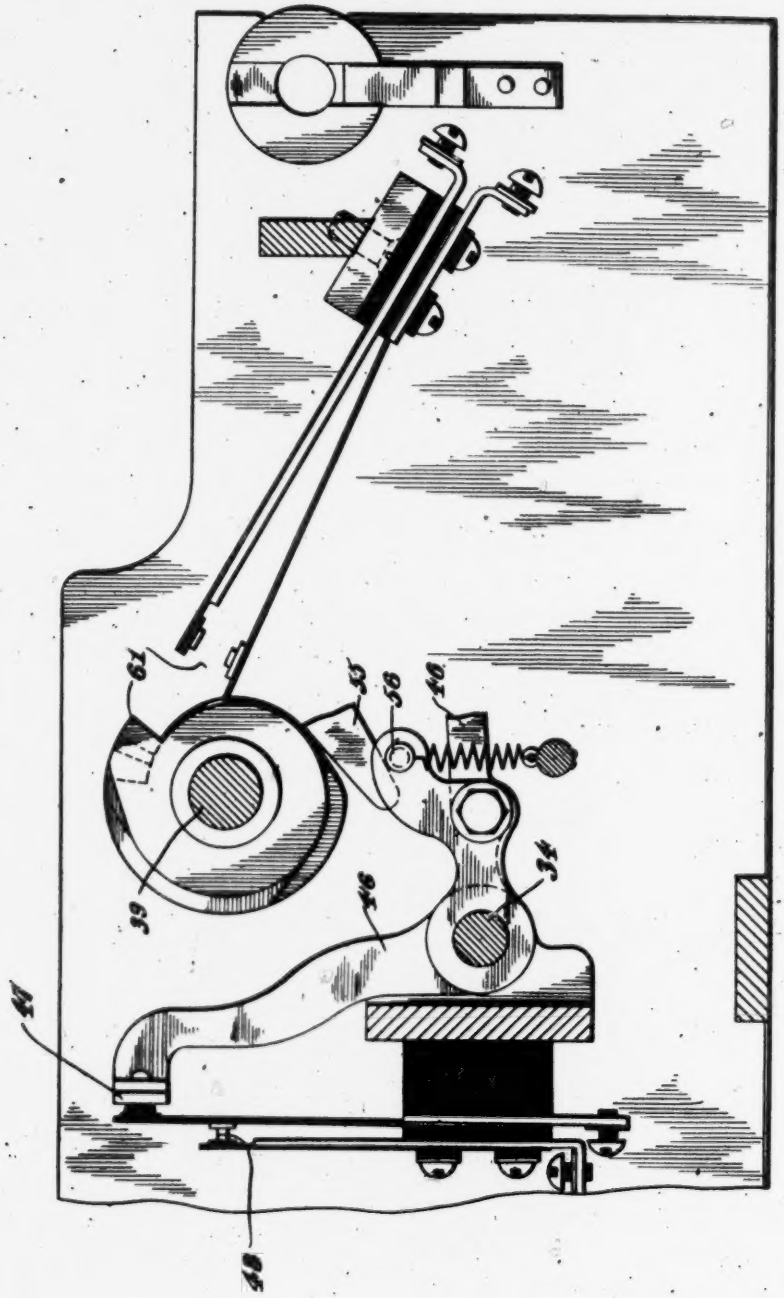
Fig. 12.



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AUTOMATICALLY CONTROLLED PRINTING TABULATOR

Original Filed April 30, 1921 13 Sheets-Sheet 8

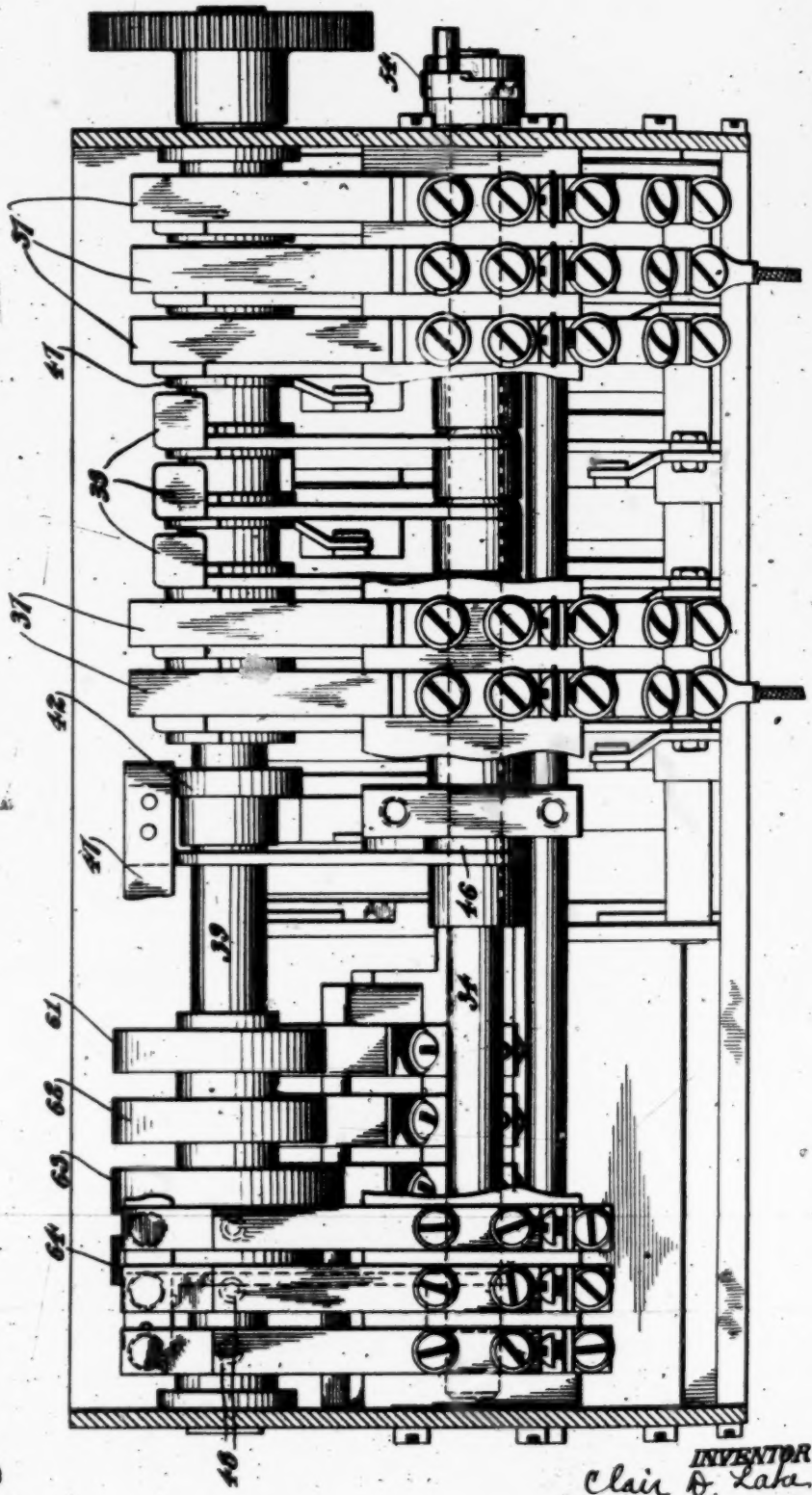

Fig. 13.

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AUTOMATICALLY CONTROLLED PRINTING TABULATOR

Original Filed April 30. 1921 13 Sheets-Sheet 9

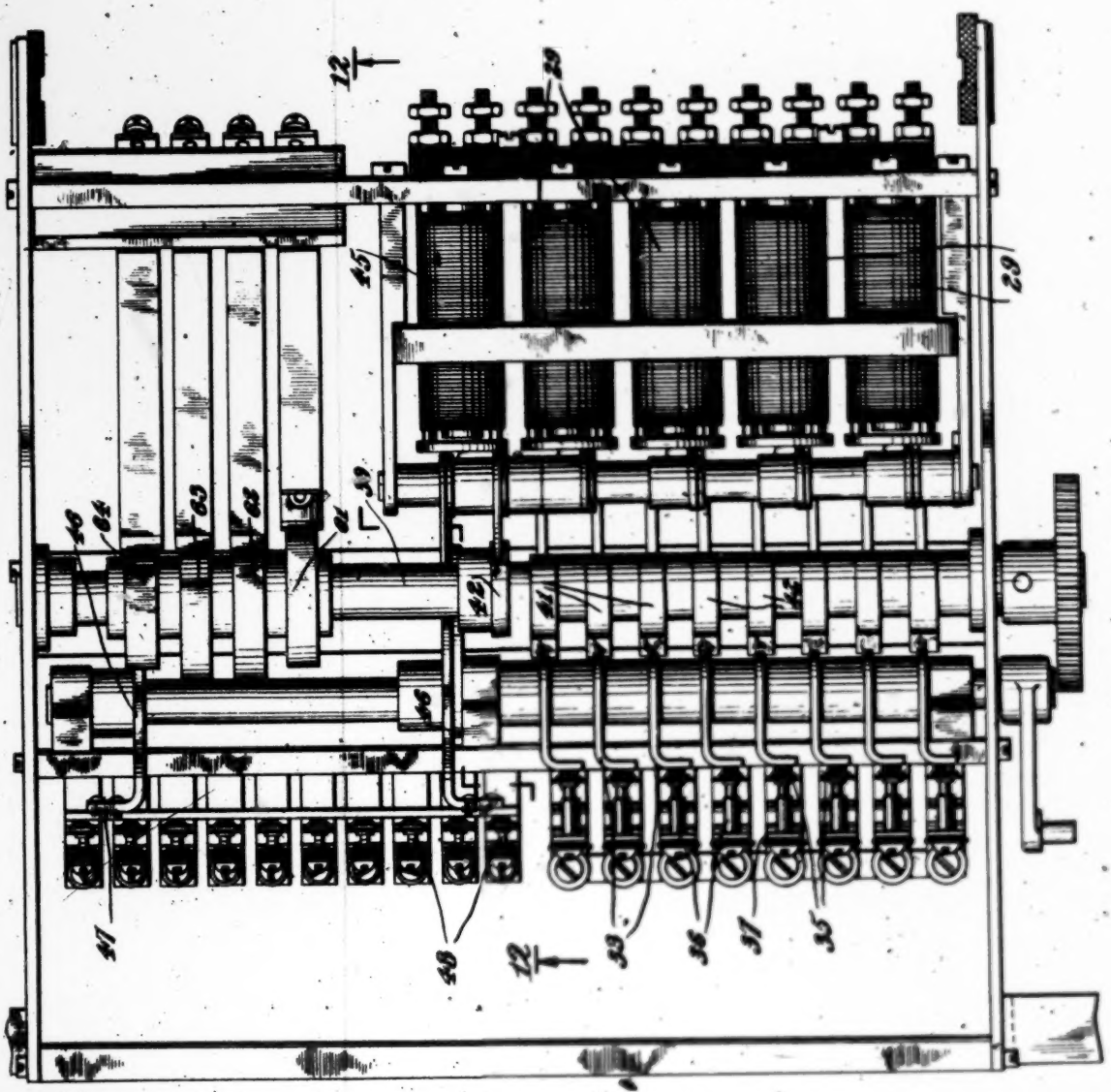

Fig. 14.

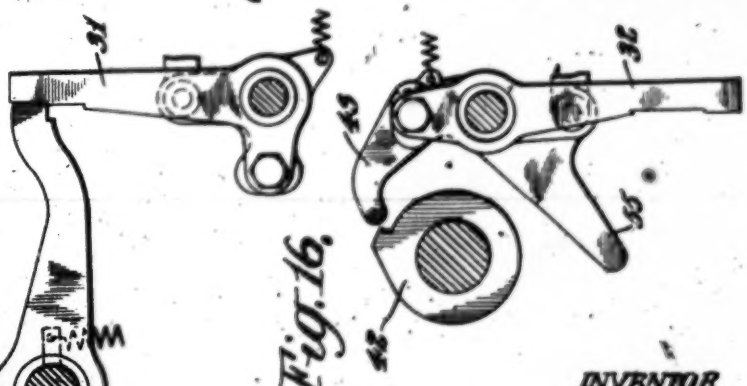

Fig. 16.

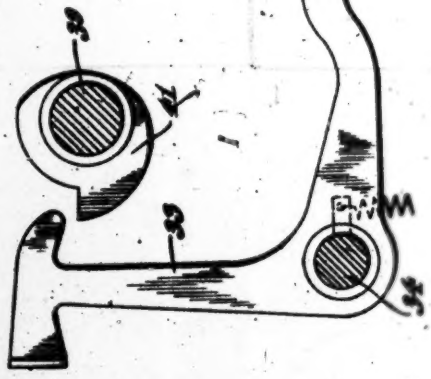

Fig. 15.

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AUTOMATICALLY CONTROLLED PRINTING TABULATOR

Original Filed April 30, 1921 13 Sheets-Sheet 10

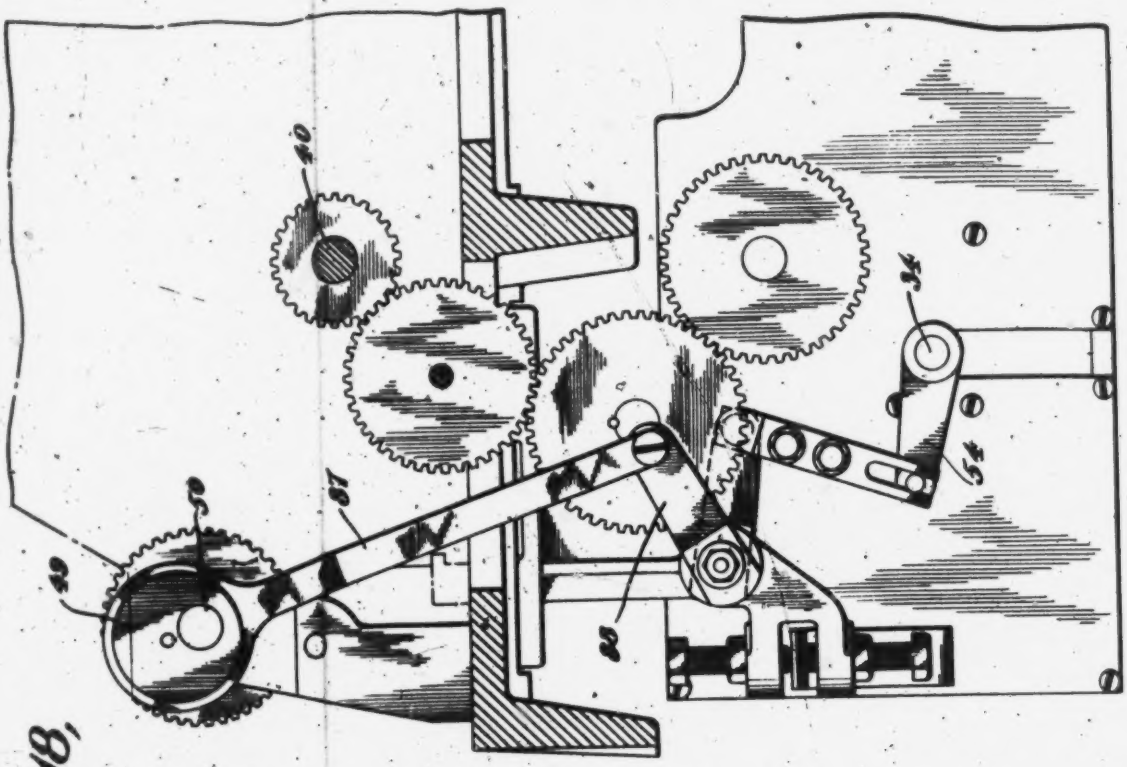

Fig. 18.

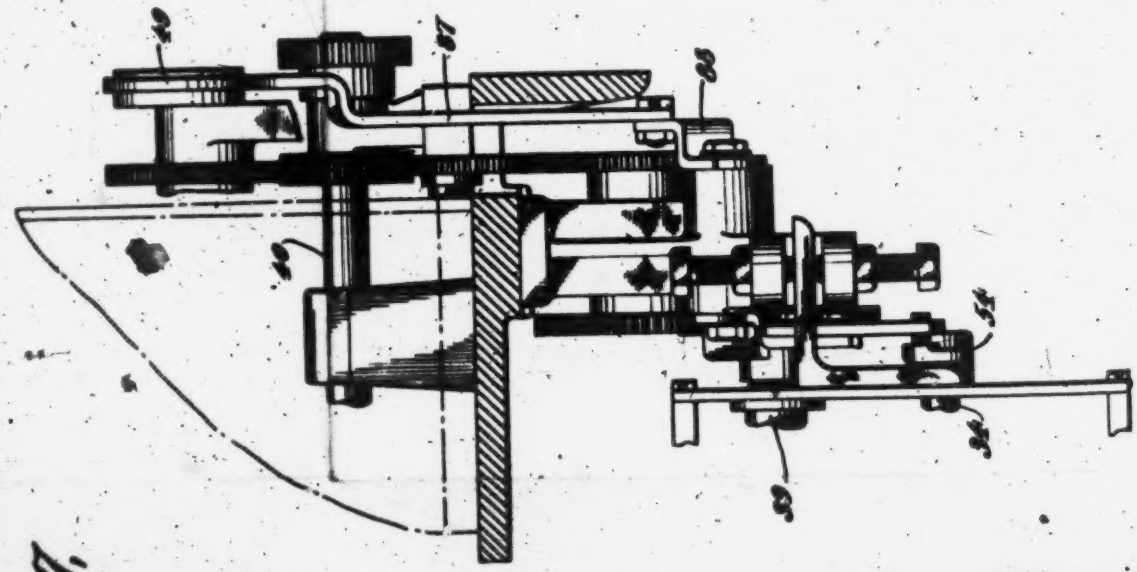

Fig. 17.

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AUTOMATICALLY CONTROLLED PRINTING TABULATOR

Original Filed April 30, 1921 13 Sheets-Sheet 11

Fig. 21.

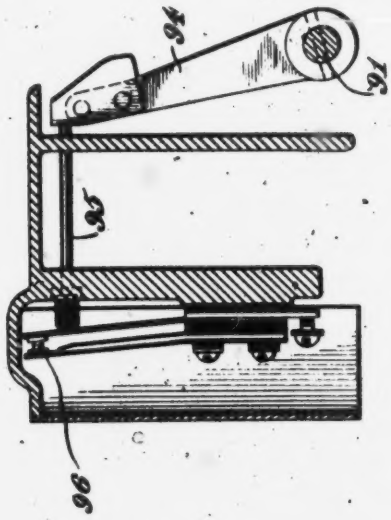


Fig. 19.

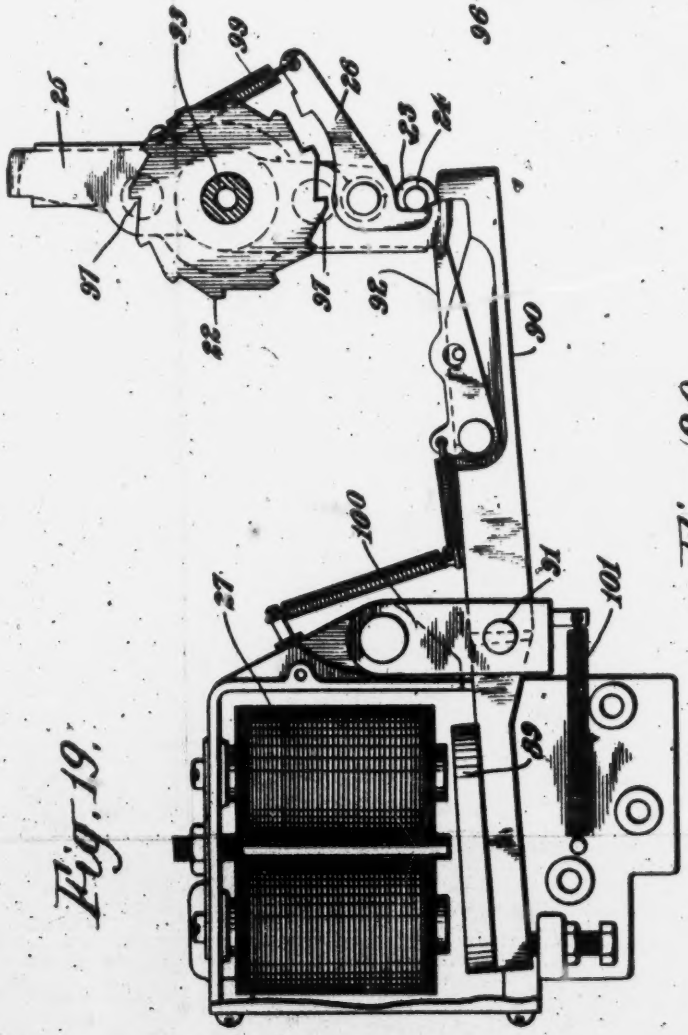
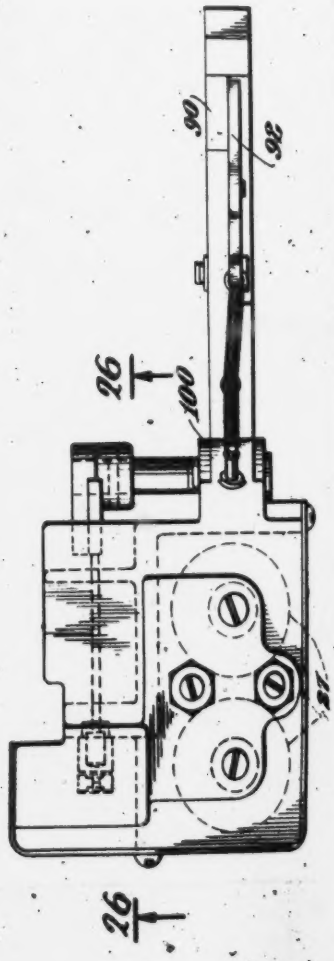


Fig. 20.



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AUTOMATICALLY CONTROLLED PRINTING TABULATOR

Original Filed April 30, 1921 13 Sheets-Sheet 12

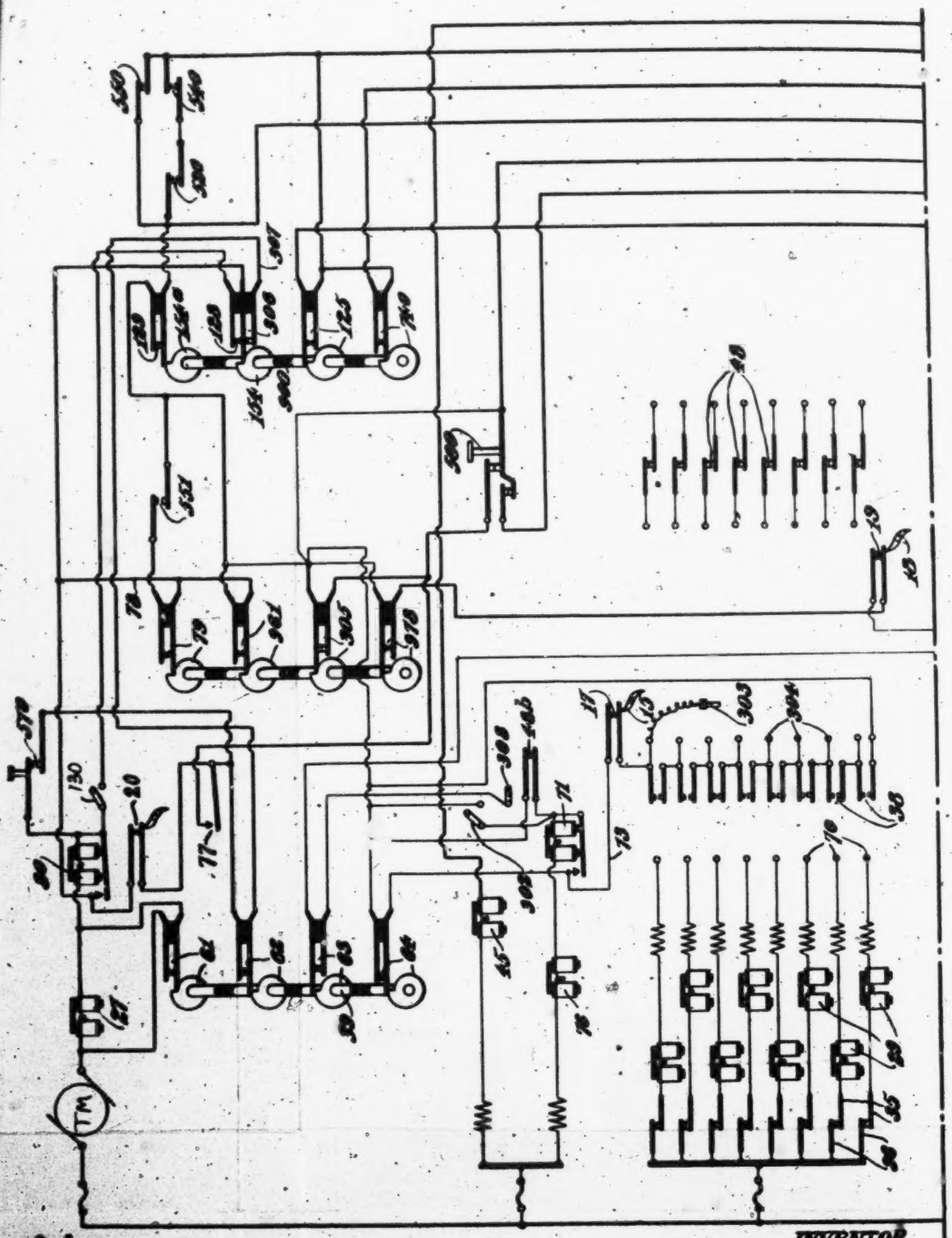

Fig. 22.

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AUTOMATICALLY CONTROLLED PRINTING TABULATOR

Original Filed April 30, 1921 13 Sheets-Sheet 13

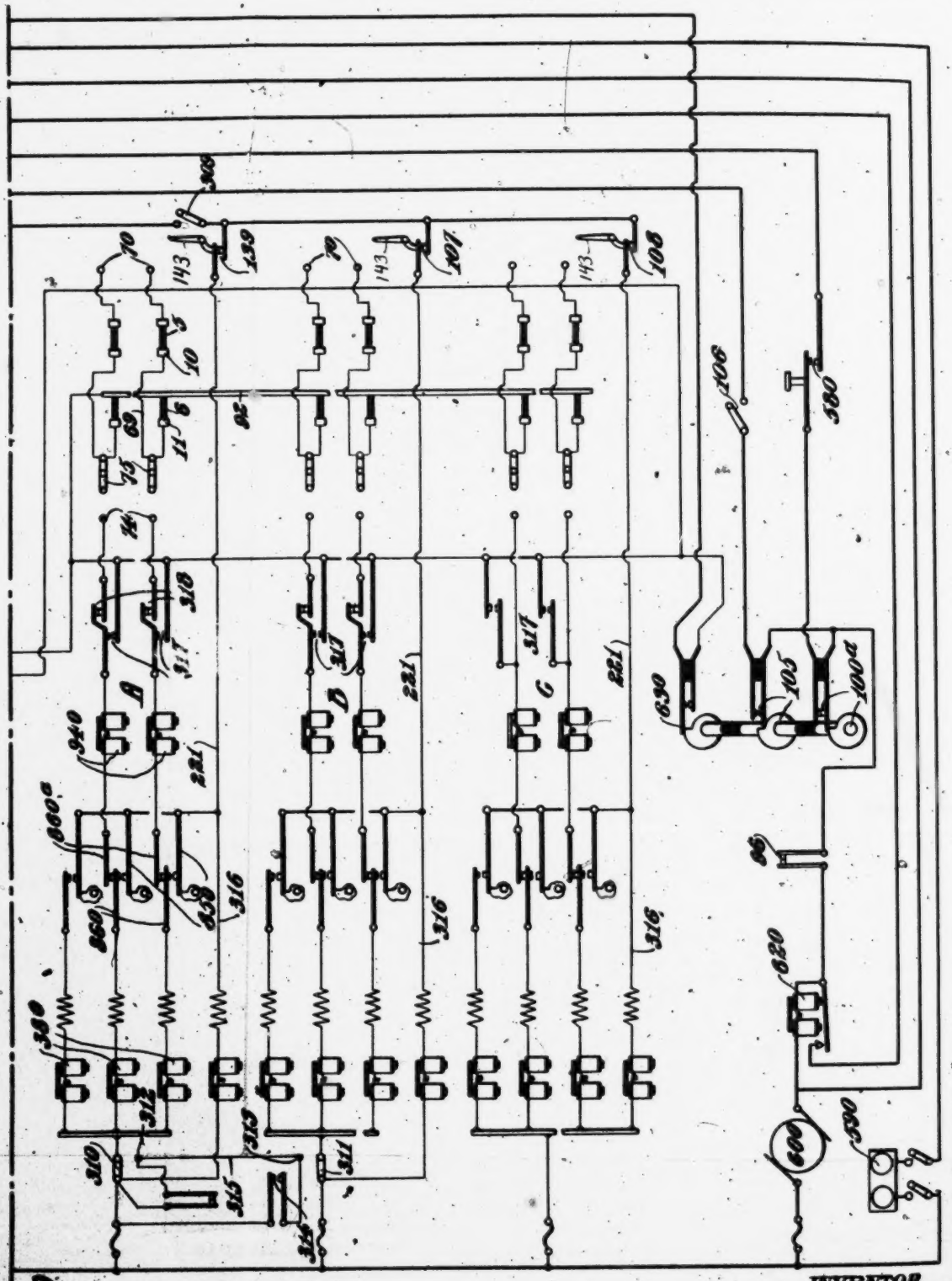

Fig. 220.

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Patented Sept. 21, 1926. 1,600,413

UNITED STATES PATENT OFFICE.

CLAIR D. LAKE, OF BINGHAMTON, NEW YORK, ASSIGNOR TO THE TABULATING MACHINE COMPANY, OF ENDICOTT, NEW YORK, A CORPORATION OF NEW JERSEY.

AUTOMATICALLY-CONTROLLED PRINTING TABULATOR.

Original application filed April 30, 1921, Serial No. 465,868. Divided and this application filed December 6, 1921. Serial No. 520,271.

This application is a division of my copending application Serial No. 465,868, filed April 30, 1921, and an improvement upon my Patent No. 1,379,268, dated May 24, 1921.

In the patent above referred to I have shown a printing tabulator in which provision was made for automatically stopping the tabulator by means of a stop card when card groups change, then automatically taking a total of the items tabulated, and thereafter restarting the tabulating operation upon the succeeding card group.

The object of the present invention is to provide an improved automatic control device for a machine of this character which is adapted to automatically stop or otherwise modify the operation of the machine upon a change of a control or group member.

Broadly, the provision of an automatic control device is not new with me, but heretofore such devices have, when applied to a Hollerith type tabulator, utilized two sets of brushes, one broad and the other narrow, which brushes cooperate and compare two successive cards. In the present invention the use of wide and narrow brushes is obviated with the attendant necessity for careful timing of the controlling circuits. Furthermore the previous constructions have necessitated the employment of a comparatively large number of relays and in the present embodiment the number of these relays has been materially reduced and the general construction simplified.

A further object of the present invention resides in the provision of an automatic control device which is flexible so as to permit one or more card columns to be used for automatic controlling and further to provide a device of this character which may be cooperatively associated with a group indicating mechanism so that certain columns and counters may be used either for controlling and group indicating or for straight accumulating.

A further object of the present invention resides in the combination of the automatic control device with resetting devices and devices for restarting tabulating upon the next card group automatically after resetting is completed.

A further object of the present invention resides in the provision of a control device of such character that control may be effected upon one or a plurality of columns and in which the control or group numbers will be indicated; together with the provision of means for indicating group numbers in other columns which are not used for controlling the operation of the machine.

The present application is further directed to a construction in which the automatic control devices are adapted to automatically call into action the printing devices to take a total. Provision is also made for automatically restarting the tabulator upon the completion of the taking of the printed total or totals.

The detail arrangement of the printing device for taking the total is fully shown and described in the patent above referred to, and in the present application recourse will be had principally to the circuit diagram to show the modifications which are necessary in my former machine to effect the automatic taking of totals and the automatic resumption of tabulating operation under the control of the auto control device.

Another object of the present invention is to provide means for printing upon the record sheet the group number when the group changes and when a total is taken under the control of the auto control device. Provision is made for suppressing the printing of the group number except for the first listed item and when printing a total. If the machine is to be used for tabulating without listing, the group number may be printed for each group total.

Another object of the present invention is the provision of a control device of such character that the control may be effective upon one or a plurality of columns, in which the group will be indicated and printed as above, and in which other columns may be merely indicated and recorded without effecting the control over the stopping of the machine or of the automatic taking of a total.

Other objects of the invention reside in the provision of certain means which may be selectively operated to cut in or out of operation the group indicator and printer, the auto control devices, the automatic total taking devices, the automatic restart devices, and other elements of the system whereby an exceedingly flexible arrangement may be secured which will permit various combina-

tions of operations to be secured upon the same machine.

The accompanying drawings illustrate the complete control attachment and its method of operation.

Fig. 1 is a view in elevation of a Hollerith tabulating machine showing the manner of attaching the printing device thereto.

Fig. 2 is a side elevation of the feed mechanism of a tabulator which differs from the usual form of feed and is required for carrying out the present invention.

Fig. 3 is a central vertical section of the feed mechanism of the tabulator, on the line 3—3 of Fig. 4.

Fig. 4 is a rear view in elevation of the working parts within the case of the feed mechanism.

Fig. 5 is a front view in elevation of a portion of the feed device, a part of the exterior casing being removed.

Fig. 6 is a view in elevation of a portion of the gearing and parts of the feed mechanism, viewed from the opposite side to Fig. 2.

Fig. 7 is a detail view of parts of the upper brush holder.

Fig. 8 is a sectional view of the same on the line 8—8 of Fig. 7.

Fig. 9 is a front view of the lower contact blocks.

Fig. 10 is a detail view of the upper and lower card levers and associated parts shown in Fig. 3.

Fig. 11 is a view in elevation of an electromagnet and circuit controller forming part of the control unit or apparatus.

Fig. 12 is a sectional detail of a cam and circuit controllers, taken on the line 12—12 of Fig. 14.

Fig. 13 is a front view of the parts shown in Fig. 11 taken on the line 13—13 of that figure.

Fig. 14 is a plan view of the controlling magnets and associated parts of the controlling unit.

Fig. 15 is a detail of the latch mechanism associated with the control magnets.

Fig. 16 shows a mechanical release for the control magnet armatures.

Figs. 17 and 18 are end and side views of driving parts of the controlling unit, tabulator and attached parts.

Fig. 19 is a view in elevation of a clutch-controlling magnet and its associated parts.

Fig. 20 is a top plan view of the same.

Fig. 21 is a sectional view of the circuit-controller operated by the clutch magnet.

Figs. 22 and 22ª together constitute the wiring diagram of the apparatus shown in the preceding figures.

So far as it is possible to do so without confusion, I have used the same numerals to designate corresponding parts in all of the above-described figures.

To accomplish the objects of this invention, I add to the tabulator a control mechanism or unit, and add to the card feed mechanism of the tabulator proper an extra set of brushes. That is to say, in addition to the usual brushes always employed, I employ an upper set of brushes whose function is to cooperate with the lower set to effect a comparison of two cards and bring about the desired control thereby. The two sets of brushes are at such distance apart that they will register with corresponding hole positions on two consecutive cards as they pass through the machine. Under this arrangement, if both sets of brushes make a simultaneous contact with control holes of the same numerical value, nothing results to interfere with the normal running of the machine. But if the control or group number changes on any card and is not the same on the upper as on the lower card then the control circuit is affected and the tabulating operation interrupted.

I will first describe such mechanical devices as I have devised and which are necessary for the purpose of effecting such control, and afterwards more fully set forth the operation in connection with the circuit diagram figures.

In Fig. 2 which shows the feed mechanism, the lower gear wheels 1 are a part of the train of gears commonly used in tabulators for feeding the cards. In this device I use the driving gear wheel 2 in addition to its usual function, to operate the upper set of wheels 3. The connecting rod 4, from wheels 3, is similar to that ordinarily used in tabulators for drawing the cards singly from a pack into the machine where they are engaged by the feed rolls.

There are two sets of brushes, 5 the upper and 6 the lower. The upper brushes 5 are carried by metal plates 7, Fig. 8, secured to an insulating base plate 8, each brush being insulated from all the others. The lower brushes 6 are carried by a metal bar 9 (Fig. 3) which is common to all of them, and both upper and lower brushes when a perforation passes under them, make contact with corresponding individual, separate blocks 10 and 11 respectively, each of said blocks being insulated from any other block. The cards are drawn down to the upper rolls 12, and are passed by these and similar pairs of rolls below them through the chute 13 for the upper brushes and then through the chute 14 for the lower brushes. In all other respects than those noted the construction and arrangement of the device is the same as in the ordinary tabulator with the single exception, perhaps, that an upper lever 15 extends across the upper chute in the path of the cards which, when a card passes, shifts a pin 16 that brings together two contacts 17, while a second or lower

card lever 18 is similarly placed in the lower chute that, when a card is passing, closes two sets of contacts 19 and 20.

The feed mechanism is driven by a belt and pulley 21, Fig. 4, to which pulley is fixed a ratchet wheel 22, shown also in Figs. 2 and 19. On the drive shaft 93 is fixed a clutch arm or bar 25, and loose upon this arm is a second arm 23. Pins 97 in bar 25 enter enlarged holes, not shown, in the bar 23 and limit its sidewise play. A pin 24 is set in clutch bar 23 and is to knock out and hold the pawl 26 free from engagement with the ratchet 22. This pawl is pivoted to bar 25 and when engaging with the ratchet 22, it carries the two bars 23 and 25 around with the driving pulley.

On the completion of the circuit to the tabulator motor, in a manner to be hereafter explained, the current passes through and energizes a clutch magnet 27, Fig. 19, causing it to attract the armature 89 thereby imparting motion to the clutch lever 90 to which said armature is fixed, and drawing it away from engagement with the clutch bars 23 and 25.

When the energized magnet 27 has, through the instrumentality of clutch lever 90, released the bars 23 and 25, the pawl 26 is pulled into engagement with the ratchet 22 by its springs 99, and this causes the clutch bar 23 to travel around slightly in advance of the bar 25.

During each cycle a pin 98, Fig. 4, secured to the gear wheel 1, comes into engagement with a knock off lever 94, Fig. 21, which is secured to shaft 91. As clutch lever 90 is also pinned to this shaft, it tends to knock off the armature 89, and at such time the clutch magnet shunt contacts, as will be more fully understood by subsequent description, are made in order to break the magnetism of the said magnet. However, if the motor circuit has not been broken, the clutch magnet will again be energized, when these contacts are made again, and thus prevent the stopping of the machine.

As will also be more fully set forth, should the motor circuit be broken by the change of a control number in a card, by the depression of the stop key or by the last card of a group, the clutch magnet 27 will not be energized, and after the knocking off by the pin 98 of its armature the latter will not return, and the end of the clutch lever 90 will be in a position to engage the ends of the clutch bars 23 and 25. This engagement is so timed as to bring the machine to a positive stop in a predetermined position.

As explained above, the clutch bar 23 in its running position is slightly in advance of the bar 25, so that when the end of the clutch lever 90 rises into its path, the arm 25 strikes first the pin 24, working against the tail of the pawl 26, and pulls the latter out from engagement with the ratchet 22 and allows the over-run of the motor to be taken up by the now loose pulley wheel. Latch 92 drops in behind arm 25 to take the rebound of the machine. The shaft 91 is mounted in pivoted bearing plates 100 and is held against the magnet box by the spring 101. This provides for the overthrow or momentum of the machine being cushioned.

Actuated by the knock off lever 94 is a plunger 95 which operates a pair of contacts 96. When magnet 27 is energized, these contacts break the circuit to the reset mechanism and prevent its starting during the tabulating cycle. When the tabulator stops, however, and the clutch is latched up these contacts are made and the machine may be reset either manually or automatically. The operations of total taking, resetting, and restarting the tabulator will be set forth later.

The control unit which I have illustrated herein is arbitrarily designed for the control of eight columns of a tabulator card. This number may be greater or less if so desired. It is enclosed in a suitable box or casing 28 and secured in any convenient position and manner to the frame of the tabulator, preferably as shown in Fig. 1. The casing contains, in this case, eight column control magnets 29, Figs. 11, 14, 22 and 22ª, each having an armature 30 that is connected to a pivoted overlapping latch lever 31 or 32. When a magnet is energized and attracts its armature the latch lever releases a spring-actuated lever 33, pivoted at 34, which falls away or to the right from a contact 35, normally in engagement with a contact pin 36 carried by a spring-actuated arm 37. This results in the separation of the contacts 35 and 36 and permits the arm 37 to close contacts 38 which are normally open.

In the control unit is a shaft 39 which receives motion by gears from the counter drive shaft 40 (see Fig. 18) and this shaft carries cams 41 (Fig. 11) having high points which at a given instant in each cycle engage the cam ends of levers 33 and close the contacts 35 and 36, and relatch said levers with the latch levers 31 and 32. This operation takes place once in each cycle.

On the same shaft 39 is a cam 42 which, towards the end of each cycle, engages the end of a lever 43 pivoted at 44, the lower end 43ª of which carries a cross rod or bail 43ᵇ which in its movement knocks off the attracted armatures 30 by striking the overlapping levers 31 and 32 and insures the reengagement of these levers 31 and 32 with the lever 33.

Passing now to Figs. 12 and 14: As stated above, there are eight column or control magnets 29, and in addition there is a group

indicator magnet 45, which operates one of the latch levers 32 to release a lever 46 fast on shaft 34, and operating a bail 47 which controls all of a set of ten contacts 48, which are known as group indicator contacts. During the reset of the machine the shaft 34 is rotated through a short arc by means of an eccentric cam 49 (Fig. 18) on the reset to zero shaft 50 of the tabulator which is connected by linkage 87—88 with a fixed arm 54 which rocks the shaft 34. This movement of the shaft rocks the lever 46 (Fig. 12) and permits it to relatch with the latch lever 32, and at the same time to close contacts 48. The same movement rocks a lever 55 by the engagement therewith of a pin 56, and thereby knocks off the armature 30 of the group indicator magnet (see Fig. 11).

In the diagram Fig. 22 are shown four cam contact devices 61, 62, 63 and 64. The cams of these contact devices are fast on the shaft 39 and are insulated from it and from each other.

In further explanation of the invention, let it be assumed that a sorted group of cards, or two or more groups of different cards, are passed through the tabulator which is to record or display the totals of the values represented by item holes punched in these cards. Each group of cards is distinguished by control holes punched in one, two or according to the provision made in this particular machine, eight different columns at the same time. The cards are placed in the hopper 65 and the tabulating machine started in operation in the usual manner by depressing start key 570.

Referring now to the diagram Figs. 22 and 22ª, depression of the tabulator start key 570 closes the circuit from the line through tabulating motor T M, clutch magnet 27, motor relay 80, start key 570, motor control relay contacts 77, through cam contact devices 305 now closed, through cam contact devices 129, through contacts 550, to the other side of the line. If a listing operation is to be performed, the same circuit is closed as before, with the exception of the fact that current flows from cam contacts 129 through the contacts 520 and 540, to the other side of the line, which insure the machine being driven at the lower listing speed, as in my prior patent previously referred to. It may be here explained that the cam contact devices 61 to 64, inclusive, are all driven by a shaft 39 which is driven in unison with the tabulator. Cam contact devices 305 are driven by a shaft 220 which is shown in Fig. 4. This shaft is driven in unison with the tabulator card feeding devices as shown in Fig. 2, and corresponds with the identical shaft in my previous patent.

The cam contact devices 129 are driven by a shaft 900 in the printing attachment. During normal tabulating operations this shaft is stationary and is only set in operation upon the taking of totals and the resetting of the tabulator counters to zero, as in my previous patent.

Having now described how the tabulator is set into operation, I will set forth in more complete detail the automatic control devices whose function is to interrupt the tabulating operation at the end of a card group or when successive cards do not correspond in their group characteristics.

In the automatic control unit as shown there are eight group indicator contacts 48 and two extra contacts 48ª and 48ᵇ, one, 48ª, for setting up the control relay 71 and the other for completing the circuit when using the counters for plain indicating without controlling. The first of the last two contacts mentioned above, when all the contacts are closed, energizes the relay 71, which is held closed by the action of cam-controlled contacts 64, to be hereinafter further referred to.

The feed mechanism is started either automatically or by the operation of the tabulator start key 570 in the manner previously explained, and the cards begin to travel through the machine, as the clutch magnet 27 connects the feed mechanism with the drive. As the cards pass one by one down through the chutes 13 and 14 nothing happens until the first card passes under the lower brushes 6, and thereby closes contacts 19 and 20, the contacts 17 having already been closed by the upper card lever 15.

Assuming that only cards which are all in the same group are passing through the machine, the control numbered holes pass under both upper and lower brushes at the same instant of time. This permits a circuit to be completed from any given lower brush 6, Figs. 22 and 22ª, to contact block 11 and thence by wire 69 to the contact block 10 of the corresponding upper brush, and from thence to the brush 5 itself. From the upper brush the circuit is continued to the plug board and for convenience of reference the particular plug holes connected together in advance, are both marked 70 in the diagram, one plug connection being used for each column, and as many used as desired. This permits the current to pass through one of the column control magnets 29 and back to the source. The control magnet thus energized, breaks contacts 35 and 36 for the purpose of taking the arc from the brushes, and makes contacts 38 (see Fig. 11) which complete a part of the shunt containing the control relay 71. The same result follows from the passage of the brushes over all the other holes in the control columns which may have been plugged in, i. e., 70—70 etc., and the shunt circuit is thereby completed. During the card cycle cam contacts 64 are momentarily separated but this does not affect the

relay 71 because the circuit 73 through the contacts 38 is closed, otherwise the circuit through the relay would thus be broken. The plug 303 can be plugged into any of the plug sockets 304 to cut out of action one or more column control circuits when less than the full number of columns are being used for controlling.

Near the end of the passage of the first card under the lower brushes, cam controlled contacts 630 are closed and this directs a current through the group indicator magnet 45 and this releases the lever 46 and permits the bail 47 to fall away from and open all of the contacts 48, and so long as no interruption to the running of the machine occurs, these contacts remain open. It may here be pointed out that the group indicator contacts 48 are plugged in between the points 74 and 75, that is, between the brush plugs and the counters for preventing the establishment of circuits after the first card has passed through, and after the first number has been set up upon the counter.

From the above it will appear that so long as the successive cards contain corresponding control holes, the necessary circuits are maintained complete and the normal operation of the machine continues.

Now let it be assumed that the last card of a group has passed the upper brushes. When this card comes under the lower brushes the first card of the next group is under the upper brushes, but this card having one or more control holes of a different numerical value, which do not correspond to the control holes in the last card of the first group under consideration, the circuit is therefore interrupted between the upper contact brush 5 and its block 10, and this results in the breaking of the circuit 69 and the failure of the magnets 29 to become energized. This leaves contacts 38 open and interrupts the shunt circuit 73, which, on the opening of the contacts 64, de-energizes the relay magnet 71 and breaks the circuit of the motor relay 76 which allows contacts 77 to separate and breaks the circuit at that point. These contacts 77 are shunted by the circuits 78 through cam contacts 961 when tabulating, or cam contacts 79 when listing, which break towards the end of the cycle, de-energizing the motor relay 80 and the tabulator clutch magnet 27. This results in the positive stoppage of the machine, as will now be understood from the description of Fig. 2.

It is manifest from the above description that the presence of a misplaced card in any group of cards, which has a control hole that does not correspond with that or those in the other cards will result in the same operation, and will stop the machine.

The foregoing description has explained the method of automatically stopping the tabulating operation by means of the automatic control devices. It will now be assumed that it is desired to manually or automatically take a total. If a total is to be taken manually, switch 106 is opened as shown and reset key 580 is depressed. This allows current to flow from source 590 through contacts 550 when tabulating, or 540—520 when listing, therethrough through contacts 129, now closed, thence through conductors to the reset key 580, through reset key 580, contacts 100ª, now closed, clutch magnet controlled contacts 96, reset magnet 620, reset motor 600 to the other side of line and back to source. It may be here explained that cam contacts 100ª, 105 and 630 are disposed upon a shaft which is driven by the tabulator concurrently with the rotation of shafts 39 anl 220. The rotation of the reset motor 600 effects the printing of the total and the resetting of such counters as are selected to be reset, in the manner explained in my patent heretofore referred to. After initiating a totaling and reset operation by reset key 580, the flow of current through the reset motor is taken over by means of a relay arm controlled by magnet 620 which shunts out reset key 580. After the totaling and resetting operation is initiated, magnet 620 is short-circuited. Control of the printing and reset motor is taken over by contacts 740, which are mounted on shaft 900 and driven during the printing and resetting operation. These contacts at the end of the printing and resetting cycle break the circuit to motor 600 and stop further rotation thereof. The means for first taking a total and thereafter resetting is controlled by the magnet 620, in the manner explained in my previous patent. In addition, it may be here explained that the contacts 96 prevent the operating of printing and resetting when the tabulating motor (T M) is running and has energized clutch magnet 27 which opens contacts 96.

If it is desired to take a total automatically, switch 106 is closed. Then just before the tabulator comes to rest after its control by the auto control device, cam contacts 105 will be closed and these contacts will initiate the total printing and resetting operation which will then be completed in the manner heretofore described. It may be explained that the circuit to switch 106 extends to the contacts controlled by stop key 560. Therefore, if this emergency stop key is opened for any purpose, the machine will not automatically take a total until the stop key is again closed.

A total having been taken, either automatically or manually, the restarting of the tabulator upon the next card group may

be effected either automatically or manually. If the manual operation of restarting is desired, the operator merely depresses start key 570 which initiates a new tabulating operation, as previously described. However, if it is desired that the tabulator automatically start up and tabulate, a total switch 130 will have been previously closed. This switch establishes a new starting circuit traced as follows: From source 590 through tabulating motor (T M), clutch magnet 27, motor relay 80, switch 130, cam contacts 128, which are closed just at the end of the printing and resetting operation by cam 154, around motor relay 80 through lower card lever contacts 20 (now closed since there are cards in the machine), through motor control relay contacts 77 (now closed), thence either through cam contacts 305 or stop key control contacts through conductors to cam contacts 129 (now closed) through one or the other of contacts 550 or 520—540 to the other side of the line and back to source. This circuit initiates the tabulating cycle automatically. The tabulator then continues running by virtue of the closure of the contacts of motor relay 80 until stopped by the automatic control devices at the end of the next card group in the manner heretofore explained. The tablulator is then brought to rest and additional totals may be taken, automatically or manually, the counters reset, and the tabulator restarted again, automatically or manually, as desired.

It will be assumed that a card group has been tabulated and that there are no additional cards in the machine. Provision must be made for interrupting the automatic tabulator starting circuit. Under these conditions the lower card lever control contacts 20 will be interrupted upon the passage of the last card past the lower brushes and therefore will interrupt the automatic starting circuit previously traced and prevent the automatic restarting of the tabulator. It will also be appreciated that when there is no additional card group in the machine upon which the tabulator can start up, that provision must be made to pass the last card of the old group through the machine, since the items must be taken off this card, tabulated, listed, if desired, and a total taken. After the last card of the group passes the upper brushes, the control circuit previously explained as flowing through these brushes is made on all contact blocks and all upper brushes 5. This, in effect, energizes all control circuits plugged in, thereby alowing the card feed to continue and remain uninterrupted until the last card has passed the lower brushes 6 and lower card lever 18, thereby opening the contacts 19—20 controlled by this lever. Opening of contacts 19 opens the circuits to the upper and lower brushes.

By maintaining the control circuit 73 in this manner, relay 76 will keep contacts 77 closed for an extra card cycle after passing the lower brushes, thereby permitting the card feed to continue during that cycle, irrespective of the opening of cam contacts 64.

In this operation it is necessary to insure that the machine stop exactly at the position well known in the art as the D stop position, i. e. the normal home position of the parts of the machine, after the last card has passed out beyond the lower card lever 18. To do this the holding circuit 307 is provided which extends from cam contacts 154—306 to cam contacts 62, thence to relay contacts 77, and thence to the other side of the line through cam contacts 305, cam contacts 129 and contacts 550 which were traced. This holding circuit maintains the tabulator in operation until just before the D position is reached when the holding circuit will be broken by contacts 77 by the de-energization of relay magnet 76 which is effected by the breaking of contacts 64, which contacts are in the automatic control circuit. Just prior to the breaking of the contacts 77, another circuit will maintain the tabulator motor in operation. This circuit is marked 78 and allows current to flow through motor T M clutch magnet 27, motor relay 80, through 78 and one or the other of cam contacts 961 or 79, the former being used in straight tabulating and the latter in listing, thence through contacts 129 and through one or the other of contacts 520—540 or 550 to the other side of the line. Just before the D position is reached either cam contacts 961 or 79 open, thereby interrupting the tabulator motor circuit and bringing the machine to a stop at exactly D position.

Just before the tabulator has come to a stop, under these conditions, the total will be automatically taken and the machine reset under the control of the cam contact devices 105 in the manner previously explained. After this taking of the total and resetting, the machine will not restart on a new tabulating cycle, since the lower card lever contacts 20 are open due to the absence of cards and these open contacts thereby interrupt the entire circuit to the auto start cam contacts 128 thus preventing restarting of the tabulator automatically.

The purpose of the cam contacts 61 is to short circuit the clutch magnet 27 momentarily at the time the armature 89 is being knocked away from said magnet 27 mechanically by means of the pin 98, as previously explained. This insures a positive stopping of the machine and disengagement of the clutch.

Cam contacts 63 serve to control the count-

ing of cards which pass through the machine. These cards may be counted on in desired counter, a suitable plug connection being connected in at 308 which extends to any selected counter magnet plug socket 74.

Cam contacts 305 operate in conjunction with stop key 560 to insure that the machine will come to a stop at the D position when circuit connections are interrupted by the opening of the stop key 560 control contacts.

Cam contact devices 978 in connection with lower card lever contacts 19 serve to control the supply of current to the common plate 92 which is connected to the lower brushes 6. The purpose of this circuit and controlling contacts is to allow current to flow during the passage of a card past the brushes and to interrupt the flow of current at the intervals between the cards so that erroneous additions and printing will not be effected at such times.

The cam contacts 129 serve to open up the tabulator circuit during the totaling and resetting operations so that the tabulator cannot be restarted upon tabulating operations until total taking and resetting is substantially completed.

Cam contacts 100ª in conjunction with contacts 96 controlled by clutch magnet 27 serve to prevent the taking of a total or the resetting of the tabulator counters during tabulating operations. These devices are similar to corresponding devices in my previous patent.

The cam contacts 630 serve to control the supply of current to the group indicator magnet 45 at the proper time of the cycle. The purpose of these contacts is to make the circuit to the group indicator magnet after the first card of a group has passed and has set up the proper indication upon the counter wheels and also effected the proper type setting in the printing or listing attachment.

The cam contacts 125 serve to control the flow of current at the proper time to the circuits 221 which lead to the total taking contacts 850 and 860, the former being controlled by cams 840 in the manner described in my previous patent. In circuit with contacts 860 are the printing and listing magnets 380. Contacts 860 when in cooperation with 860ª are used for listing and when in cooperation with 850 are used for total taking as in my previous patent.

To selectively control the printing of totals from the various counters, three switches, 108, 107 and 139, are provided. By the opening of these switches the printing circuits corresponding to one or the other or all of the counters may be cut out of the operation thereby preventing the taking of a printed total. If it is desired to cut out all the total printing magnets simultaneously, a switch 309 is opened thereby interrupting the circuit to cam contact devices 125.

It will be understood that in the present application, the listing magnets are permanently in circuit with the counter magnets 940 and that whenever registering occurs there will be corresponding energization of the listing magnets. Listing or non-listing will be controlled by the manipulation of the listing lever in the manner explained in my previous patent.

Switch 302, shown in the diagram, is thrown to close a circuit which entirely cuts the automatic control devices out of operation when the machine is to be used on straight tabulating without regard to automatic control when groups change.

Switches 310 and 311 when thrown to closed position, as shown, serve to permit straight tabulating, when switch 302 is thrown to closed position to cut out the automatic control devices. When switch 302 is opened, as shown, and switches 310 and 311 are closed, as shown, controlling will be secured on both counters A and B so far as the controlling columns are connected by plug connections. This is the position used when a counter is split to tabulate on certain wheels and control on other wheels or columns. If all of the wheels for the first counter are to be used for controlling, switch 310 may be either in the position shown or thrown to connect pole 312. In either of these positions the group number or characters will be indicated and printed when the first card passes through, when listing, and repeated when a total is taken. If, however, the counter marked A is to be split, using certain columns for controlling and other columns for indicating, it is necessary to throw the switch 310 to connect with pole 312. In this case, the columns of the counter which are connected and print the group number for the first passing card when listing, repeat the same when totaling and on the columns which are not connected for controlling, a similar group indication and printed record will be made. These latter columns, however, will have no effect in stopping the machine when groups change. Switch 311 is used in a similar manner on the second counter marked "B."

In the drawings I have shown two counters A and B and a third C, the former are to be used for group indicating and controlling, as previously explained. However, only eight of the sixteen columns in these two counters can be used for controlling purposes at any one time.

In taking a total with either or both of switches 311 and 310 thrown over into contact with poles 313 or 312, it is necessary to provide a path for the current flowing through the printing magnets, otherwise the group

number set up on the counters would not be printed. In order to secure a path for the group number printing circuit under these conditions, I provide contacts 314, which contacts are adapted to be closed by means of the armature of reset magnet 620 when this magnet is energized. It will be recalled that magnet 620 is energized during the total printing and resetting operation. Closure of contacts 314 permits the current to flow through a supplementary circuit 315 when switch 310 is thrown over into contact with pole 312. Circuit 315 includes contacts 314 and extends to left side of the line. This circuit permits a group designating number to be imprinted by the printer of counter A in taking a total. When, on the other hand, counter B is being employed and switch 311 is thrown into contact with pole 313, current flows to the line from the printing magnets of counter B through 311, pole 313, part of path 315 including closed contacts 314, to left side of line. This permits a group number to be printed by the printing magnets of the B counter when a total is being taken.

In printing totals it is of course desirable to print some identifying symbol, such as an asterisk (*) or like identifying character. To provide for such character I provide so-called asterisk circuits 316, one for each counter, which includes the usual printing magnet 380 and which extends directly to the left side of the line. The operation of these asterisk printing circuits is controlled directly by the total printing cam contacts 125. It will be understood that these asterisk circuits are not energized at all during the listing operations, since they are only controlled by the total taking contacts.

In the previous descriptions I have referred to counters A, B and C. These counters are of the usual Hollerith type and are contained within the housing similarly marked in Fig. 1. Each of the respective counters has printing elements in connection therewith and certain of the counters also have controlling circuits in connection therewith. These latter printing devices are located within the housing 81 shown to the right in Fig. 1. The controlling devices on the other hand are located within the housing 26 in this figure.

In a printing tabulator the counters not only set up and display the totals but also control the printing of the totals. The counter circuits also control the listing of the items. This requires that the counter magnets 940 which are energized by the punched holes to operate the counters shall, when energized, close a shunt circuit around the brushes and this shunt circuit is provided with contacts 317. The purpose of this arrangement is twofold, one is for taking the arc from the lower brush 6, and the other for maintaining the circuit through the counter magnets 940 and the printing magnets 380. This is in accordance with the regular use of a printing tabulator. Now when the control unit is used with this form of machine the same devices are used but it becomes necessary for the magnets 940 when energized to break the main circuit from the brushes through contacts 318 at the same time that the contacts 317 are closed to complete the shunt circuit. The purpose of breaking the circuits by contacts 318 is to prevent back circuits through the holes of the upper card, upon a comparison of group numbers.

Heretofore in the specification it has been explained that both registers A and B can be used for group indicating and controlling. In actual practice these registers usually contain eight counter-magnets and may therefore be termed as having eight sections which may be plugged in selectively to any columns of the record cards and the sections thereby controlled by the index points in said selected columns. Registers A and B can be split up in any desired manner to designate groups in certain section or sections on one or a plurality of registers. The registers may be similarly split and selectively utilized for automatic controlling. It is also possible to utilize both of these registers for straight accumulating operations or to split them in any desired manner utilizing certain sections in one or a plurality of them for automatic controlling, other sections for group designating or indicating and still other sections for accumulating. It may be explained that in stating that sections of the register are used for controlling that this does not imply that the register device itself is the automatic control. In this case, the section of the register which is utilized for controlling is simply used to set up the control number therein and the other devices heretofore explained in detail actually effect the automatic control. In this connection it may be stated that it is possible to automatically control without plugging in any register or section thereof. To secure such a result the operator directly plugs in from upper brush plug 70 to the control magnet plug 70 and sets switch 302 in the usual manner for controlling. No plug connection is made between 74 and 75, and inasmuch as the register is cut out the group indicator contacts are not plugged into circuit.

It is to be understood that switches 108, 107 and 139 which selectively control the printing of the totals from the various counters include bell crank members 143, the tops of which are shown in reversely illustrated position in Figure 1 of the drawings from the showing of these parts on the diagram. These bell crank members are

controlled in their operation by the reset clutches 142, as in my previous patent. When the resetting clutch of any counter is set to the left this will prevent the resetting of that counter and will also open the corresponding switch 108, 107 or 139 so as to prevent any printing of a total from the counter which is not being reset. On the other hand, if clutch members 142 are thrown in to the right the corresponding counters will be reset, the corresponding switch closed and a total printed of the amount on that counter. In some instances it may be desirable not to reset a counter and to print a total of the amounts thereon. This may be effected by pressing inward on the particular bell crank member 143, which corresponds to the counter which is not being reset whereby 143 can be disengaged from its groove in the knurled resetting clutch sleeve 142. The operator may then displace the selected bell crank member 143, to the right, as shown in Fig. 1, or to the left, as shown in Fig. 22ª, thus maintaining the contacts which are controlled thereby closed. Under these conditions the counter may not be reset but a total will be taken therefrom.

The detailed operation of the machine having been explained a brief statment will be given showing some of the results which can be accomplished upon this machine.

In the first place, the machine can be used as a straight tabulator without listing any items or printing the totals thereof. Usually in this operation the tabulator is driven at a higher tabulating speed and therefore the speed changing device is shifted over to high speed and contacts 520 are opened. The operator also opens non-total printing switch 309 which prevents the printing of totals. The tabulator may be operated now as a straight non-printing tabulator and during the tabulating of the individual items from the record cards the type carriers of the printer will be wholly ineffective. During resetting operations there will be an actuation of the parts of the printing attachment, but inasmuch as the controlling circuits are open there will be no printing of totals.

If it be desired to perform a tabulation of a run of groups of cards and print the totals, switch 309 will be closed thereby permitting a total to be printed at the end of each card group. During such a tabulating operation the listing of the individual items will be entirely suppressed and the only printing which will appear will be the totals of the accumulated items and the corresponding group numbers. By operating a tabulator in this manner it is possible to tabulate and print totals at a comparatively high speed since it is the actuation of the printing attachment which require time in a machine of this class and by suppressing the action of the printing attachment while individual cards are passing through the machine it is possible to operate the same at a much higher speed than if the printing cycle were carried out for each card.

The above operation may be carried out under fully automatic conditions or by partially automatic and partially manual operations. For example, a run of cards can be tabulated and if the automatic control switch 302 is opened in the position shown, the tabulating machine operation will be automatically interrupted when card groups change or when two successive cards differ in their group characteristics. A total-taking operation can now be initiated manually by depressing reset key 580, or if it is desired that this total-taking be initiated automatically, switch 106 is first closed. After total-taking, either automatically or by a manual initiation, the tabulator can be manually restarted upon a new card group or it can be started automatically at the completion of the total-taking operation. For manual restart it is simply necessary to press the start key 570 which initiates a new tabulating cycle. For such an operation the automatic restart switch 130 should be opened, as shown. If this switch is thrown to closed position the restarting of the new tabulating operation will be initiated automatically by the auto-restart cam contact devices.

It may be further explained that the present machine is also adapted to operate in connection with stop cards. If the well-known stop card is used, the tabulating operation will be interrupted when a stop card passes the card levers. Thereafter a total taking and resetting operation may be performed and the machine restarted upon the tabulation of the new group of cards in the manner heretofore explained. It may be mentioned that by placing a plain record card between the two groups of cards and setting the automatic control switch for controlling, the machine will automatically stop at the end of the group, take a total, and restart, since the blank card in effect is a change of designating group numbers in the record cards. A regular stop card placed in the card stack when controlling, acts in a similar manner as a blank card. With the automatic control off and a stop card inserted, it is necessary to turn the stop card upside down to cause the interruption of the tabulating operation and the automatic or manual initiation of total taking. If the total is manually initiated and the selecting device set for automatic restarting, the tabulating operation will automatically recommence on the next group. It may be further explained that when the machine is set for automatic controlling, and the stop card is inserted in the reverse man-

ner in the stack, the machine will automatically interrupt the tabulating operation and make a total, but will not automatically restart. This latter use of stop cards is sometimes of advantage when a grand total is being accumulated on one counter and the other counters are set so that the totals thereof are taken automatically.

If it is desired to list, the listing attachment is thrown into operation by means of the listing lever, as is explained in my previous patent. At the same time the speed control devices are adjusted so that the proper contacts are opened to compel the operation of the tabulator at the lower listing speed. It is now possible to both list the individual items making up an accumulation on any particular counter and to print a total thereof. It may be here explained that the listing of the group numbers differs from the construction of my former patent in that when these group numbers are used for controlling the operation of the tabulator and the taking of a total, the group numbers are not repeated for each tabulated item. In the present embodiment the group numbers when used for controlling, are printed alongside of the first listed item. Thereafter there is no printing of group numbers until the total is taken, when the group number appearing alongside of the first listed item of the group is repeated alongside of the total amount as printed on the record sheet.

In some particular cases it may be desirable to repeat the group number for each listed item when the group numbers are to be used for controlling. In this case it will not be possible to print the group number with the total. To secure this result the operator plugs in on the controlling counter direct from plugs 74 to 75 and omits entirely the plugging in of group indicator contacts 48. When this operation is carried out the switch 310 is thrown to the position shown in the diagram. In printing the record sheet, there will now be a group number printed for each of the items of the group. Controlling will be effected automatically at the end of the group but the group number will not be printed along with the total. When the group number is thus repeated it will be seen that the controlling counter is accumulating group numbers, and if a total is printed there will be a printed record made of the total of the group numbers. Inasmuch as this figure is of no value and only confusing, its printing is preferably suppressed by disconnecting the reset clutch 142 for this counter. This opens up the circuit through either switch 139 or 107, and prevents the printing of the group number totals.

Generally, in statistical work, it is preferable to show the group number at the beginning and end of the group. In some cases it may be desired to suppress the printing of the group number alongside the total. This can be effected by throwing open one or the other of the switches 107 or 139.

It is also possible to print sub-totals on one counter and a grand-total upon another counter. To carry out this operation, both counters which are accumulating items are plugged to the same brushes. The grand total counter clutch 142 is adjusted so that the counter will not be reset. In this way the printing in this counter will be suppresed until it is desired to take a grand total when the reset clutch is thrown in, thereby closing the printing circuit and allowing a grand total to be printed.

Furthermore by the use of the plug connections and by the proper manipulation of the resetting clutch members 142 and the bell cranks 143 and control switches, it is possible to obtain a wide variety of records. Various arrangements of sub-totals, grand totals and accumulative sub-totals may be secured in this manner.

I claim:

1. In a card-controlled machine of the class described, in combination, a tabulating machine for accumulating items from record cards, means therein for successively and continuously feeding said cards therethrough, an automatic control device provided with means for comparing a pair of said cards and for interrupting the continuous card feed when two successive cards are unlike in their control perforations, a printing device, and means called into operation by said automatic control device for initiating a printing operation thereby.

2. In a card-controlled machine of the class described, in combination, a tabulating machine, a printing device, analyzing means for concurrently analyzing two record cards, automatic controlled means controlled by the aforesaid means for comparing the card readings and means for initiating a printing operation when said two cards which are concurrently analyzed have certain unlike perforations.

3. In a card-controlled machine of the class described, in combination, a tabulating machine for accumulating items from record cards, means called into action upon the arrival of a record card which is unlike the preceding record card or cards for interrupting the tabulating operation, a printing device for printing totals of items accumulated in said tabulating machine, and a manual and automatic means for initiating a total-printing operation, said last mentioned means including devices operable selectively at the will of the operator, to predetermine whether an automatic operation will occur or whether a manual operation will be required.

4. In a card-controlled machine of the class described, in combination, a tabulating machine for accumulating items from record cards, means called into action upon the arrival of a record card which is unlike the preceding record card for interrupting the tabulating operation, and a printing device controlled from the record card conjointly with the aforesaid means for printing the first group number and the successive item amounts of a group of cards, said printing device having provisions for printing the total of the items tabulated and for printing in correspondence therewith the group number of the items making up said total, said printing device having provisions for suppressing the printing of group numbers between the first card of a group and the total of said group.

5. In a card-controlled machine of the class described, in combination, a tabulating machine for accumulating items from record cards, means called into action upon the arrival of a record card which is unlike the preceding record card for interrupting the tabulating operation, a printing device controlled from the record card conjointly with the aforesaid means for printing the first group number and the successive item amounts of a group of cards, said printing device having provisions for printing the total of the items tabulated and for printing in correspondence therewith the group number of the items making up said total, said printing device having provisions for suppressing the printing of group numbers between the first card of a group and the total of said group, and means for initiating the total printing and corresponding group printing operation at the end of a card group.

6. In a card-controlled machine of the class described, in combination, a tabulating machine for accumulating items from record cards, means called into action upon the arrival of a record card which is unlike the preceding record card for interrupting the tabulating operation, a printing device controlled from the record card conjointly with the aforesaid means for printing the first group number and the successive item amounts of a group of cards, said printing device having provisions for printing the total of the items tabulated and for printing in correspondence therewith the group number of the items making up said total, said printing device having provisions for suppressing the printing of group numbers between the first card of a group and the total of said group, and automatic means for initiating a total and group printing operation at the end of a card group.

7. In a card-controlled machine of the class described, in combination, a tabulating machine for accumulating items from record cards, means called into action upon the arrival of a record card which is unlike the preceding record card for interrupting the tabulating operation, a printing device controlled from the record card conjointly with the aforesaid means for printing the first group number and the successive item amounts of a group of cards, said printing device having provisions for printing the total of the items tabulated and for printing in correspondence therewith the group number of the items making up said total, said printing device having provisions for suppressing the printing of group numbers between the first card of a group and the total of said group, means for initiating a total and group printing operation at the end of the card group, and means for thereafter initiating a tabulating operation upon the succeeding card group.

8. The invention set forth in claim 7 in which the means for initiating a restarting of the tabulator is automatically operable upon the completion of the total-printing operation.

9. The invention set forth in claim 7 in which both manual and automatic means are provided for initiating the total-printing operation at the end of a card group and in which settable means are provided to predetermine whether an automatic operation will occur or whether a manual initiation will be required.

10. The invention set forth in claim 7 in which both manual and automatic means are provided for initiating the restarting tabulating operation upon the completion of total-printing operation and in which settable means are provided to predetermine whether an automatic operation will occur or whether a manual initiation will be required.

11. In a card-controlled machine of the class described, in combination, a tabulating machine for accumulating items from record cards, means called into action upon the arrival of a card which is unlike the preceding record card for interrupting the tabulating operation, a printing device for printing totals of items accumulated in said tabulating machine, means for initiating the total-printing operation upon the interruption of the tabulating operation, means for manually or automatically initiating a new tabulating operation upon a new card group after the total-taking operation of the previous group and settable means to predetermine whether an automatic new tabulating operation will occur or whether such new tabulating operation must be manually initiated.

12. In a card-controlled machine of the class described, in combination, a tabulating machine for accumulating items from record cards, means called into action upon the arrival of a card which is unlike the preceding

record card for interrupting the tabulating operation, a printing device for printing totals of items accumulated in said tabulating machine, means for automatically initiating the total-printing operation upon the interruption of the tabulating operation without restarting the tabulator upon the succeeding card group.

13. The invention set forth in claim 12 in which means is provided for manually initiating a tabulating operation upon a new card group after the automatic total-taking of the previous group is completed.

14. In a card-controlled machine of the class described, in combination, a tabulating machine for accumulating items from record cards, means called into action upon the arrival of a card which is unlike the preceding record card for interrupting the tabulating operation, a printing device controlled from the record card conjointly with the aforesaid means for printing totals of items accumulated in said tabulating machine, means for automatically or manually initiating a total-printing operation upon the interruption of the tabulating operation and settable means to predetermine whether said total printing operation shall be initiated manually or automatically, and means for automatically initiating the tabulating operation of the next card group after the total-taking operation is completed for the previous group.

15. In a card-controlled machine of the class described, in combination, a tabulating machine for accumulating items from record cards, means called into action upon the arrival of a card which is unlike the preceding record card for interrupting the tabulating operation, a printing device controlled from the record card conjointly with the aforesaid means for printing totals of items accumulated in said tabulating machine, means for automatically or manually initiating a total-printing operation upon the interruption of the tabulating operation and settable means to predetermine whether said total printing operation shall be initiated manually or automatically; and means for manually initiating the resumption of tabulating operations upon the succeeding card group after the total is taken of the previous group.

16. In a card-controlled machine of the class described, in combination, a tabulating machine, a printing attachment including type carriers which are normally ineffective and idle during accumulating operations of the tabulating machine, an automatic control device for interrupting the tabulating operation when card groups change, and means for thereafter calling said printing attachment into operation to take a total of the items accumulated by the tabulator.

17. The invention set forth in claim 16 in which the means for calling the printing attachment into operation is automatically operable upon the interruption of the tabulating operation.

18. The invention set forth in claim 16 in which the means for setting the printing attachment into operation, comprises a manually operable member.

19. The invention set forth in claim 16 in which means is provided for initiating a new tabulating operation upon the completion of the total-taking operation.

20. The invention set forth in claim 16 in which automatic means is provided for initiating a new tabulating operation upon the completion of the total-taking.

21. The invention set forth in claim 16 in which both a manually and automatically operable means are provided for initiating the resumption of tabulating operations after total-taking, said last mentioned means selectively operable at the will of the operator.

22. In a card-controlled machine of the class described, in combination, a tabulating machine, analyzing means for perforated records, a printing attachment having driving connections, said attachment being controlled by said analyzing means, an automatic control device controlled conjointly with the printing attachment by the aforesaid analyzing means, said automatic control device having provisions for interrupting the tabulating operation when record groups change, and means operative by disabling the driving connections for said printing attachment for preventing movement and displacement of the printing attachment during tabulating operations.

23. In a card-controlled machine of the class described, in combination, a tabulating machine with provisions for accumulating items from record cards, a printing attachment therefor, automatic control devices adapted to interrupt the operation of the tabulating machine when record card groups change, means controlled by said tabulating machine for preventing the operation of the printing attachment during tabulating operations, and means controlled by the automatic control device and said tabulating machine for initiating a total-printing operation of said printing attachment.

24. In a card-controlled machine of the class described, in combination, a tabulating machine, card analyzing devices therein, means in said tabulating machine for accumulating and setting up therein items from record cards under the control of the aforesaid analyzing devices, a printing attachment having common means controlled by the aforesaid analyzing means for directly setting up items from said cards when listing, said means in the attachment being independent of the devices for setting up items upon the accumulator, independent provi-

sions for setting up upon said common means in said attachment items set up in said tabulator and automatic control devices also controlled by the card analyzing means for changing the operation of the tabulator when cards are analyzed having different controlling characteristics from preceding cards.

25. In a card-controlled machine of the class described, in combination, a tabulating machine, card analyzing devices therein, a printing attachment, common means in said attachment controlled by the aforesaid analyzer for directly setting up items from said cards when listing, independent provisions for setting up upon said common means in said attachment items set up in said tabulator, automatic control devices controlled by the aforesaid analyzer for interrupting the operation of the tabulator when cards are received therein having different controlling characteristics from preceding cards, and means operable after such interruption for initiating a total printing operation of the items accumulated in the tabulator.

26. In a card-controlled machine of the class described, in combination, a tabulating machine with provisions for accumulating items from record cards upon certain counters and setting up in other counters non-accumulative items, a printing attachment having provisions for setting up items directly from said cards for listing, and independent provisions for setting up therein the items accumulated or set up in said tabulator, automatic control devices for interrupting the operation of the tabulator when cards are received therein having different controlling characteristics from preceding cards, and means for initiating an operation of the printing attachment to effect the total-printing of the items accumulated by the accumulating tabulator counter and concurrent printing of the items set up in the non-accumulating tabulator counter.

27. In a card-controlled machine of the class described, in combination, a tabulating machine with provisions for accumulating record card items in certain counters, and provisions for setting up other record card items in non-accumulating counters, a printing attachment having provisions setting up items directly from said cards for listing, and independent provisions for setting up therein the items in both the accumulating an non-accumulating tabulator counters, automatic control devices for initiating a printing operation of the accumulative and non-accumulative items set up in said tabulator counters when cards are received in the tabulator having different controlling characteristics from preceding cards.

28. The invention set forth in claim 27 in which means is provided for automatically initiating a new tabulating operation after the printing operation is completed.

29. The invention set forth in claim 27 in which means is provided for manually or automatically initiating a new tabulating operation upon the completion of the printing operation and in which settable means are provided to predetermine whether an automatic operation will occur or whether a manual initiation will be required.

30. In a card controlled machine, in combination, tabulating devices controlled by index points of record cards, printing devices therefor, group designating means adapted to set up and print a single group designation of a group of cards, means for accumulating said designating numbers from a plurality of groups, and means for printing the total thus accumulated.

31. In a tabulating machine, in combination, a card controlled register having sections thereof adapted for independent control by the index points disposed in various columns of a record card, an automatic control device for modifying the operation of said tabulating machine when record groups change, means for selectively utilizing certain sections of said register to accumulate items from certain card columns, means for utilizing other portions of said register for designating group numbers of items in certain card columns, means for utilizing other sections of said register and certain selected card columns for automatic controlling, and means for printing group numbers, control numbers and totals of accumulated items upon a record sheet.

32. In a tabulating machine, in combination, a card controlled register having sections thereof adapted for independent control by the index points disposed in various columns of a record card, an automatic control device for modifying the operation of said tabulating machine when record card groups change, manipulative means for utilizing at the will of the operator one or a plurality of said sections of said register and selected card columns for automatic controlling, and means for printing the control numbers upon a record sheet.

33. In a tabulating machine, in combination, a plurality of card controlled registers adapted to be set in accordance with the index points of a record card, an automatic control device for modifying the operation of said tabulating machine when record card groups change, means for selectively utilizing one or more sections in one or a plurality of said registers for automatic controlling, manipulative means for selectively utilizing one or more sections in one or a plurality of said registers for designating group numbers, manipulative means for selectively utilizing one or more sections in

one or a plurality of said registers for accumulating items from record cards, and means for printing upon a record sheet group numbers, control numbers and totals of items accumulated.

34. The invention set forth in claim 33 in which means is provided for printing at the will of the operator data such as control numbers, group numbers, or totals.

35. In a card controlled tabulating machine, in combination, registering devices controlled by record cards, means for feeding record cards therethrough, an emergency stop device for interrupting the tabulator operation at any time during tabulator operation, and means for selectively determining whether tabulating operations should thereafter be resumed to complete the tabulation of a card group or whether a total taking operation should be effected.

36. In a card-controlled tabulating machine, in combination, tabulating devices controlled by record cards, a printing device for printing tabulated card data, a card counting means with provisions for counting the number of cards, said provisions operating irrespective of the position of the location of the perforations in the cards, and means controlled by said counting device for printing card count data upon a record sheet.

37. The combination with a tabulator containing a supplemental set of control contact brushes for the cards so arranged relatively to the other brushes that both contact with corresponding points on two consecutive cards at the same instant of time, of control magnets, one for each control column on a card, circuits including such magnets under control of the two sets of brushes, contacts controlled by said magnets, a circuit including said contacts and adapted to be completed thereby only when the pairs of control brushes meet perforations in the same positions on two consecutive cards at the same instant, a clutch controlling the movement of the tabulator mechanism, a magnet for operating the same which is controlled in its operation by the said circuit containing the contacts, whereby the clutch will be operated and the tabulator stopped when holes in two consecutive cards under the control brushes are not in the same relative positions thereon.

38. The combination with a tabulator containing a supplemental set of control contact brushes for the cards so arranged relatively to the other brushes that both contact with corresponding points on two consecutive cards at the same instant of time, circuits adapted to be completed by the simultaneous passage of the corresponding upper and lower brushes over holes in the same relative positions on a card, control magnets, one for each control column on a card and included in such circuits, a motor controlling electromagnet, a circuit containing the same, contacts for making and breaking such circuit dependent for their operation upon that of the said control magnets and adapted to complete the motor control magnet circuit when the control magnets are energized but to break the same when any one or more of such magnets are not energized, whereby the failure of any control magnet to become energized will result in the stoppage of the driving motor.

39. The combination with a tabulator containing a supplemental set of control contact brushes for the card so arranged relatively to the other brushes that both contact with corresponding points on two consecutive cards at the same instant of time, of a motor control magnet, a circuit containing the same, which circuit is under the control of all of the contact brushes and completed only when pairs of such brushes meet corresponding holes in two consecutive cards at the same time, and is broken when any pair of brushes do not meet such holes at the same instant of time.

40. The combination with a tabulator containing a supplemental set of control contact brushes for the cards so arranged relatively to the other brushes that both contact with corresponding points on two consecutive cards at the same instant of time, of a motor control relay, a circuit therefor, a plurality of normally separated contacts therein each of which is under the control of one pair of brushes, and closed only when such brushes meet holes under them in the same relative position on two consecutive cards at the same instant, whereby that portion of the motor control relay circuit is completed only when all of said contacts are simultaneously closed by the brushes.

41. The combination with a tubulator containing a supplemental set of control contact brushes for the cards so arranged relatively to the other brushes that both contact with corresponding points on two consecutive cards at the same instant of time, of a motor control magnet, a circuit therefor which is completed only when all the pairs of operative brushes have passed simultaneously over perforations in the same relative positions on two consecutive cards, and broken when any brush is not over a perforation at such instant of time, and means for resetting the tubulator to zero and restarting the same in operation brought into play upon the stoppage of the tabulator by the said motor control magnet.

42. The combination with the driving mechanism of a tabulator, a clutch control magnet for stopping the same and a supplemental set of control brushes so arranged

relatively to the other brushes that both contact with corresponding points on two consecutive cards at the same instant of time, of an automatic control unit for attachment to the tabulator comprising a control magnet for each control column on the cards, circuit controllers operated by said magnets, a circuit containing said circuit controllers and adapted to be completed only when all of the same are closed by the control magnets, circuits through pairs of brushes including the control magnets and completed only when the two brushes of the several pairs are over perforations in two consecutive cards which are in the same relative positions therein and a motor control relay magnet adapted to operate the clutch control magnet when during any cycle of the apparatus any of the said circuit controllers are not closed and the circuit of the relay magnet not completed.

43. In a tabulating apparatus, in combination with a control device including a card circuit having a serial connection through the perforations of a plurality of cards, said circuit upon being interrupted by a card being adapted to modify the operation of the control device.

44. In a tubulating machine, means for feeding record cards, means for comparing two cards, said means comprising a circuit adapted to be completed serially through the perforations of both cards if said perforations agree and to be interrupted by one or the other of the cards if said perforations disagree.

45. In a tabulating apparatus of the kind described in claim 44, in combination therewith, a magnet in said circuit and contacts controlled by said magnet to control the operation of the machine.

46. In a record card controlled apparatus, a plurality of card reading devices for concurrently coacting with a plurality of record cards, a plurality of circuits each including serially a pair of said reading devices, a single controlling magnet in each of said circuits, and means controlled upon the failure of any single magnet to become energized for modifying the operation of the record card controlled apparatus.

47. In a card controlled machine of the class described, in combination, a tabulating machine to accumulate items from record cards, card analyzing devices in said machine with provisions for concurrently comparing two record cards, an automatic control device controlled by the aforesaid analyzing means for comparing two record cards and interrupting the operation of the machine when said cards are unlike, and selective means for rendering said automatic control device effective or ineffective.

48. In a tabulating machine in combination with a plurality of record controlled registers, an automatic control device for modifying the operation thereof upon the occurrence of group changes in the record cards, means for selectively adjusting the control device for control by the index points in one or a plurality of columns in the record cards and in correspondence with any one or a plurality of columns of said register or registers and manipulative means for selectively controlling any selected columns in said registers for setting up designations of record card groups, said columns being selectable by the operator from any one or a plurality of index point columns on the record cards.

49. In a tabulating machine, in combination, a plurality of record controlled registers, means for selectively coupling said registers for control by the index points in any of a plurality of combinations of columns on the controlling record cards, an automatic control device for changing the operation of said registering devices when card record groups change, means for selectively coupling said control device for control by the index points of one or more columns selected from a plurality of index point columns, means for controlling the operation of certain of said registers or portions thereof to set up and designate group numbers therein and maintain such designation until groups change, and manipulative means for selectively coupling said group designating registers or portions thereof to be determined by the index points of one or more columns selected from a combination of a plurality of columns.

50. In a tabulating machine, in combination, a plurality of card controlled registers adapted to be set in accordance with the index points of record cards, means for selectively utilizing at the will of the operator one or more sections of one or a plurality of said registers for designating the group numbers of record cards, and manipulative means for selectively utilizing at the will of the operator one or more sections in one or a plurality of said registers for accumulating items from said cards.

51. In a tabulating machine, in combination, a card controlled register having sections thereof adapted for independent control by the index points disposed in various columns of a record card, an automatic control device for modifying the operation of said tabulating machine when record groups change, manipulative means for selectively utilizing certain sections of said register to accumulate items from certain card columns, manipulative means for utilizing other portions of said register for designating group numbers of items in certain card columns, and manipulative means for utilizing other sections of said register and certain selected card columns for automatic controlling.

52. In a tabulating machine, in combina-

tion, a card controlled register having sections thereof adapted for independent control by the index points disposed in various columns of a record card, an automatic control device for modifying the operation of said tabulating machine when record card groups change, and manipulative means for utilizing one or a plurality of said sections of said register and selected card columns for automatic controlling.

53. In a tabulating machine, in combination, a card controlled register having sections thereof adapted for independent control by the index points disposed in various columns of a record card, an automatic control device for modifying the operation of said tabulating machine when record groups change, manipulative means for selectively utilizing one or more sections of said register for designating group numbers of items in selected card columns.

54. In a tabulating machine, in combination, a plurality of card controlled registers adapted to be set in accordance with the index points of a record card, an automatic control device for modifying the operation of said tabulating machine when record card groups change, means for selectively utilizing one or more sections in one or a plurality of said registers for automatic controlling, manipulative means for selectively utilizing one or more sections in one or a plurality of said registers for designating group numbers, and manipulative means for selectively utilizing one or more sections in one or a plurality of said registers for accumulating items from record cards.

55. In a tabulating machine in combination with a tabulating machine having a plurality of record controlled registers, and an automatic control device for modifying the operation thereof upon the occurrence of group changes, means for selectively adjusting the control device for control by the index points in any one or a plurality of columns in the record card and in correspondence with any one or a plurality of columns of said register or registers, and means for selectively controlling selected columns only in said register or registers for setting up designations of record card groups, other columns in said registers being available for other operations such as accumulating, the said columns being selectable from any one or a plurality of index point columns on the record card.

56. In a tabulating machine, in combination, a card controlled register having sections thereof adapted for independent control by the index points disposed in various columns of a record card, an automatic control device for modifying the operation of said tabulating machine when record groups change, manipulative means for selectively utilizing certain sections of said register to accumulate items from certain card columns, and manipulative means for selectively utilizing other sections of said register and certain selected card columns for automatic controlling.

In testimony whereof I hereto affix my signature.

CLAIR D. LAKE.

Dec. 31, 1929. E. A. FORD 1,741,985

SORTING MACHINE

Filed Nov. 7, 1924 11 Sheets-Sheet 1

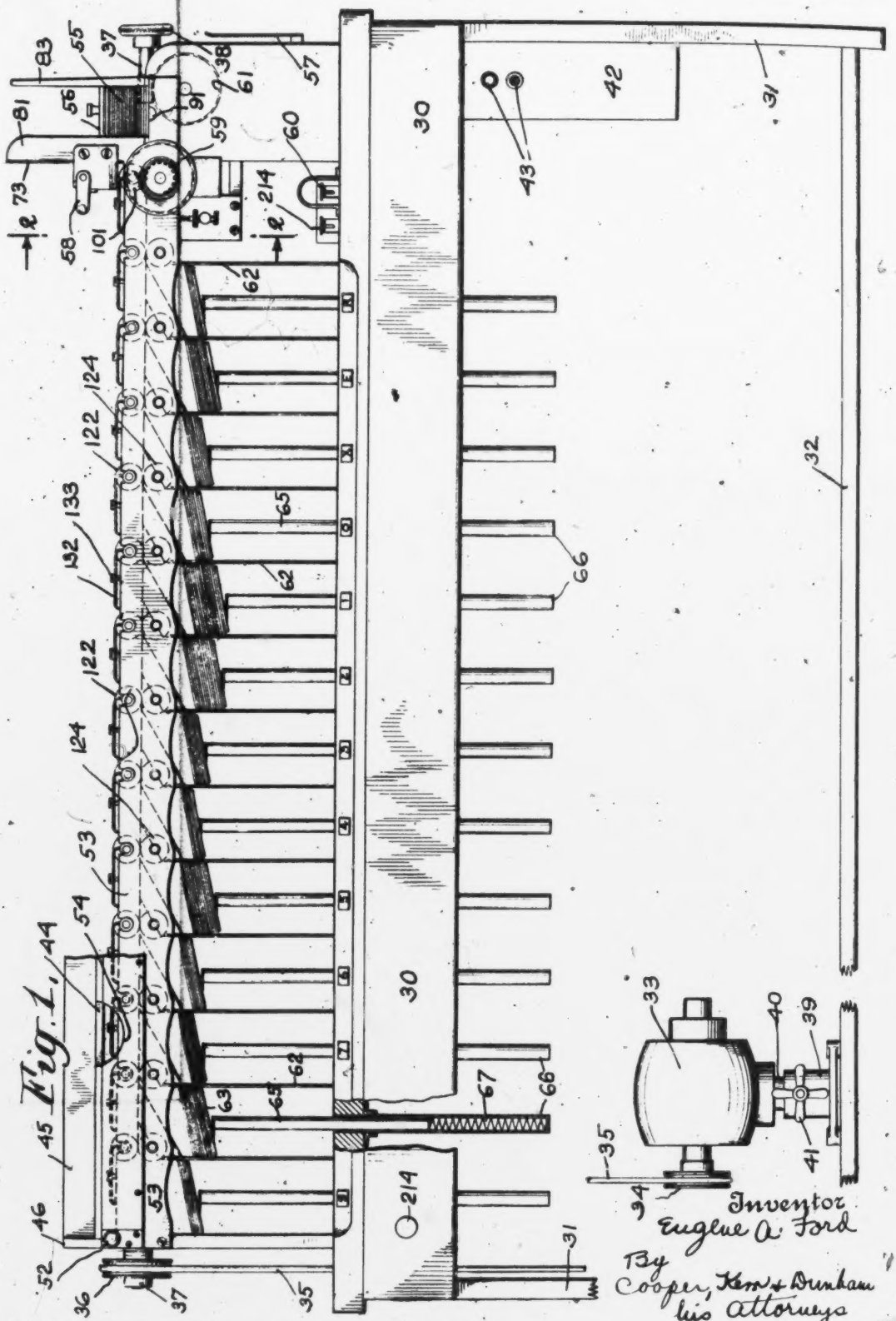

Fig. 1.

Inventor
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his Attorneys

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SORTING MACHINE

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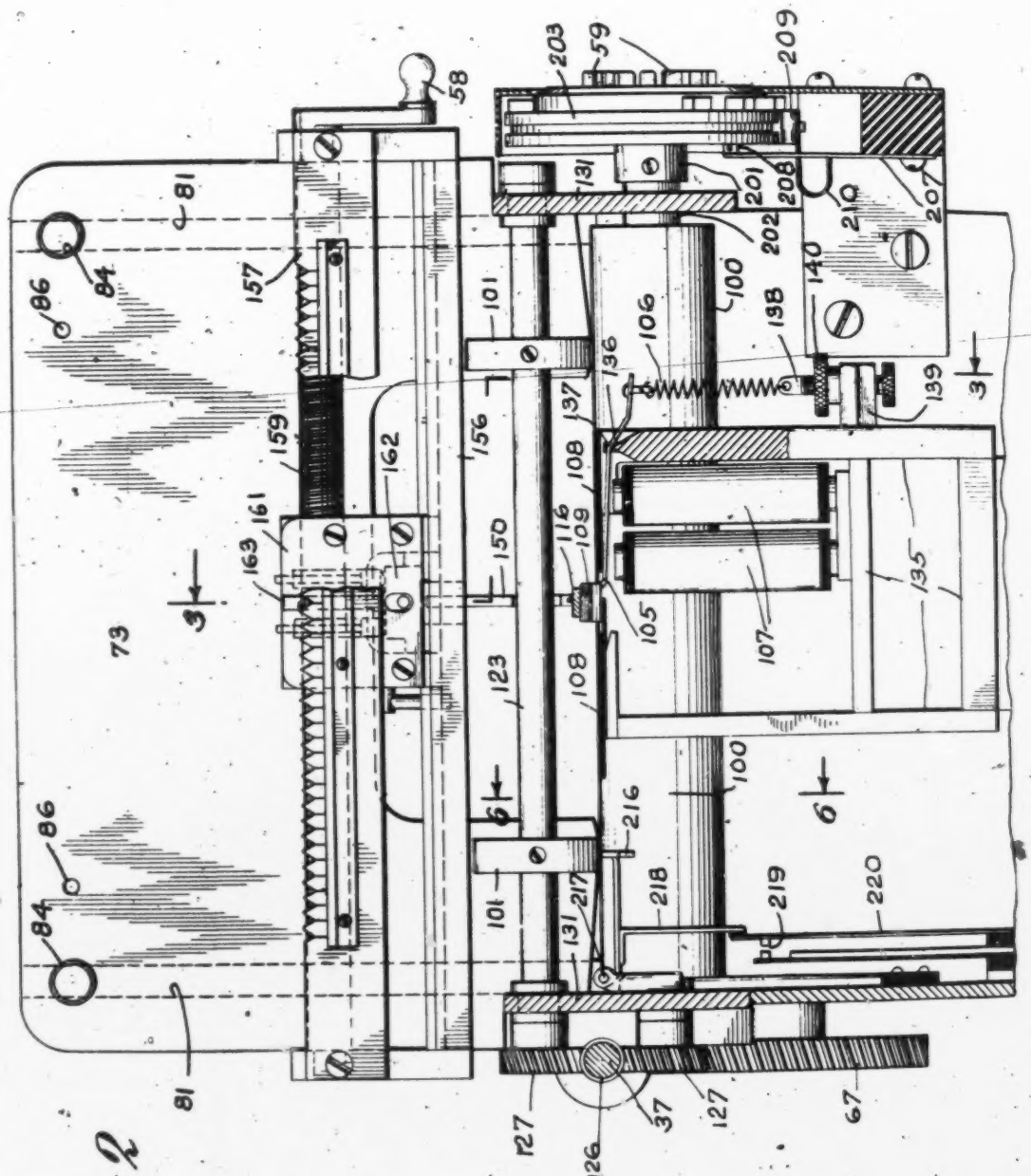

Fig. 2

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SORTING MACHINE

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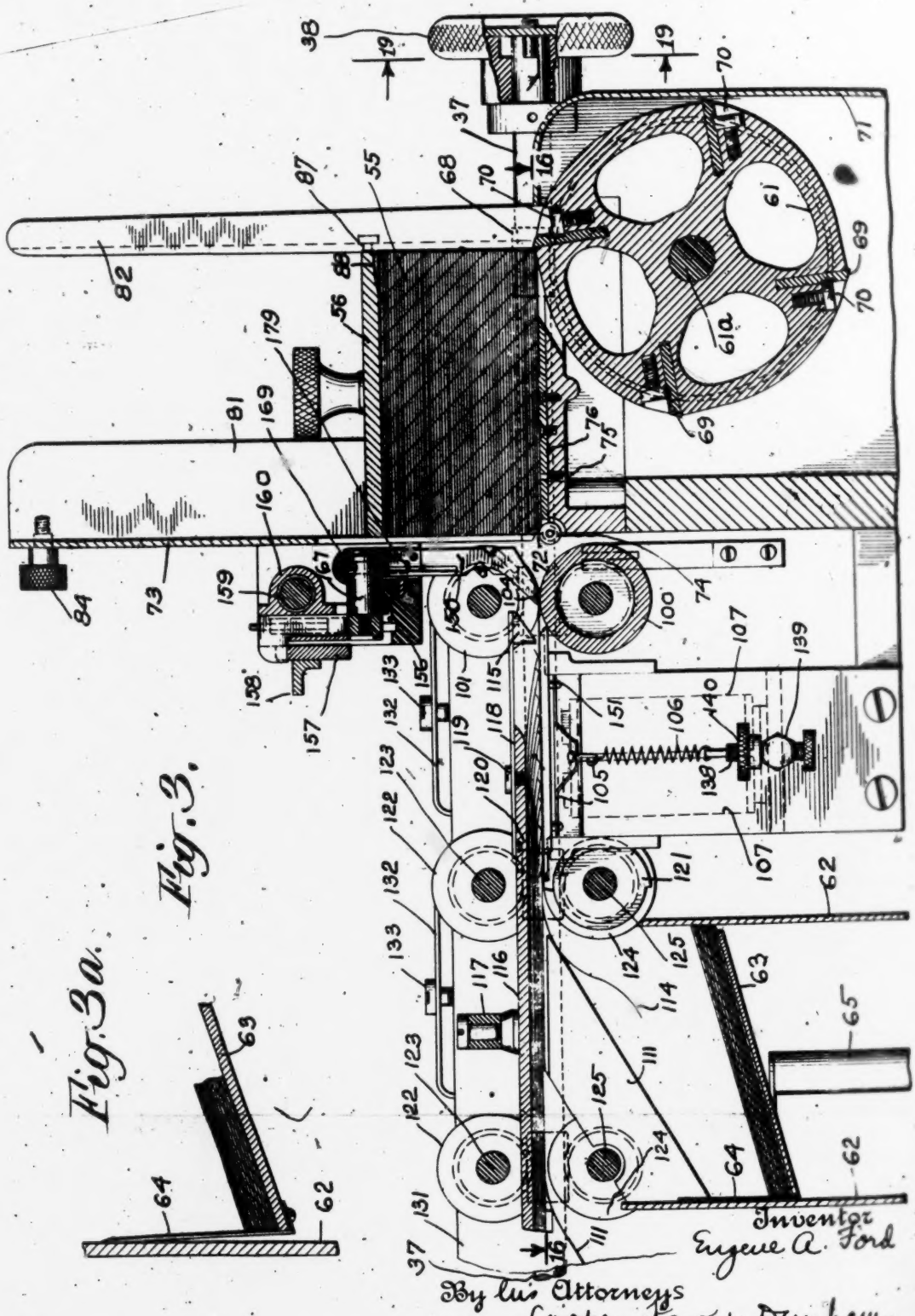

Fig. 3a.

Fig. 3.

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SORTING MACHINE

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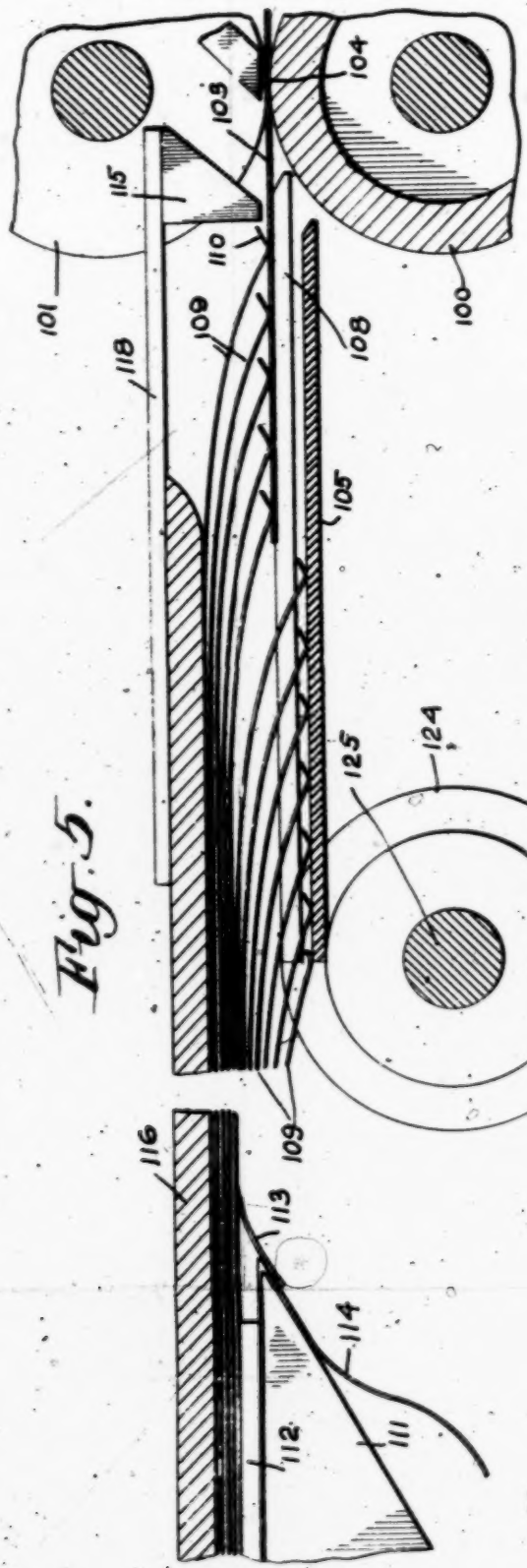

Fig. 5.

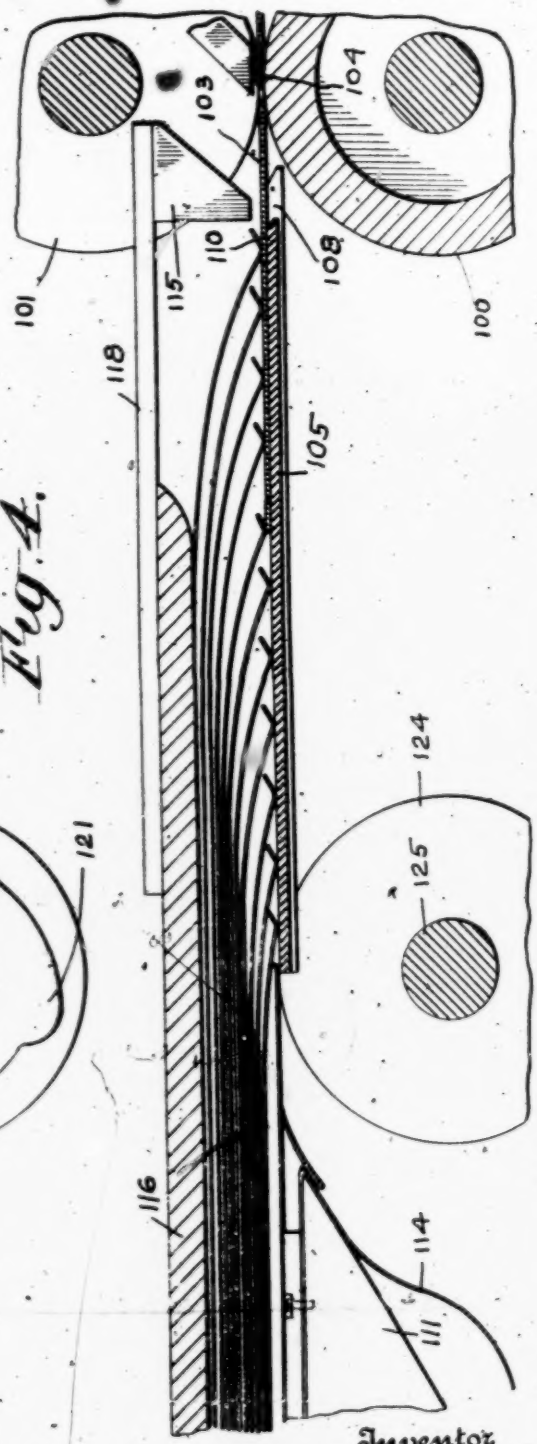

Fig. 4.

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SORTING MACHINE

Filed Nov. 7, 1924 11 Sheets-Sheet 5

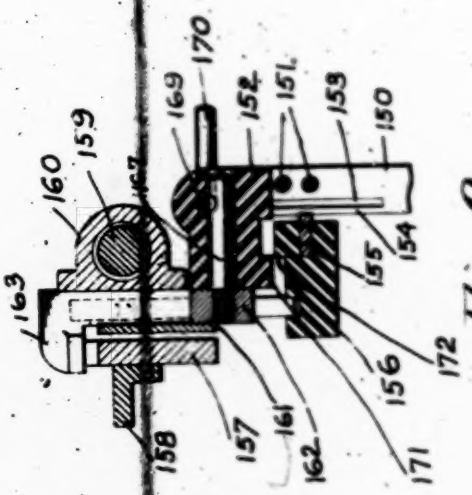

Fig. 8.

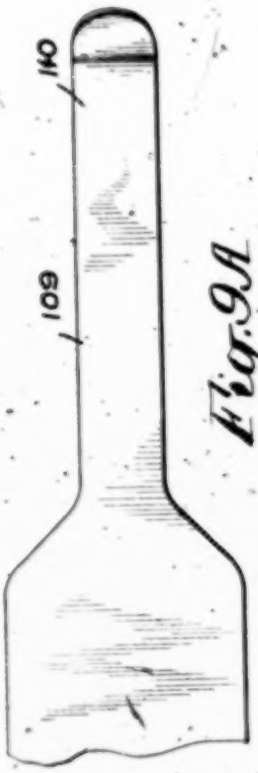

Fig. 9.

Fig. 9A.

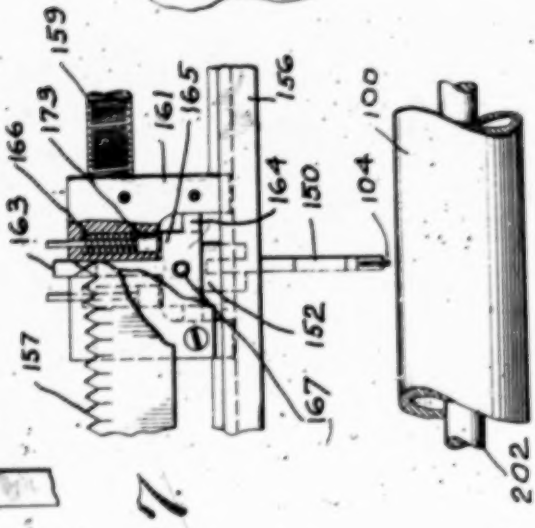

Fig. 7.

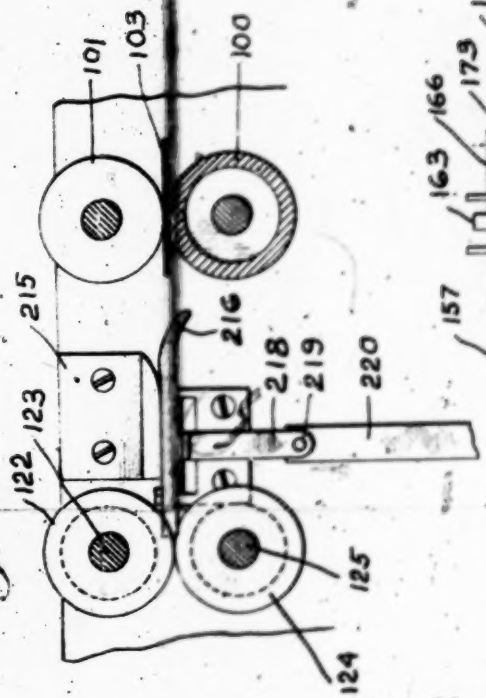

Fig. 6.

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SORTING MACHINE

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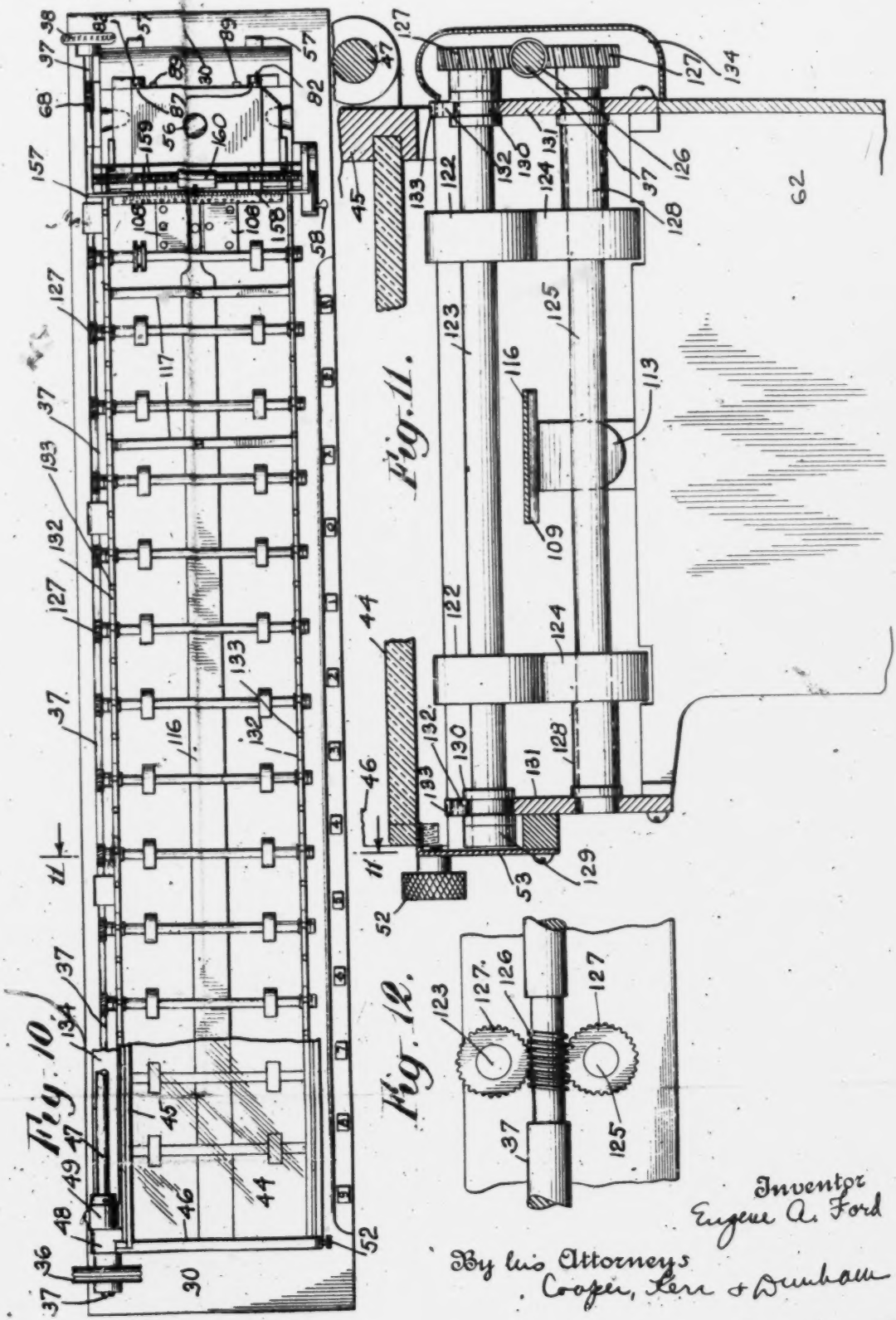

Fig. 10.

Fig. 11.

Fig. 12.

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SORTING MACHINE

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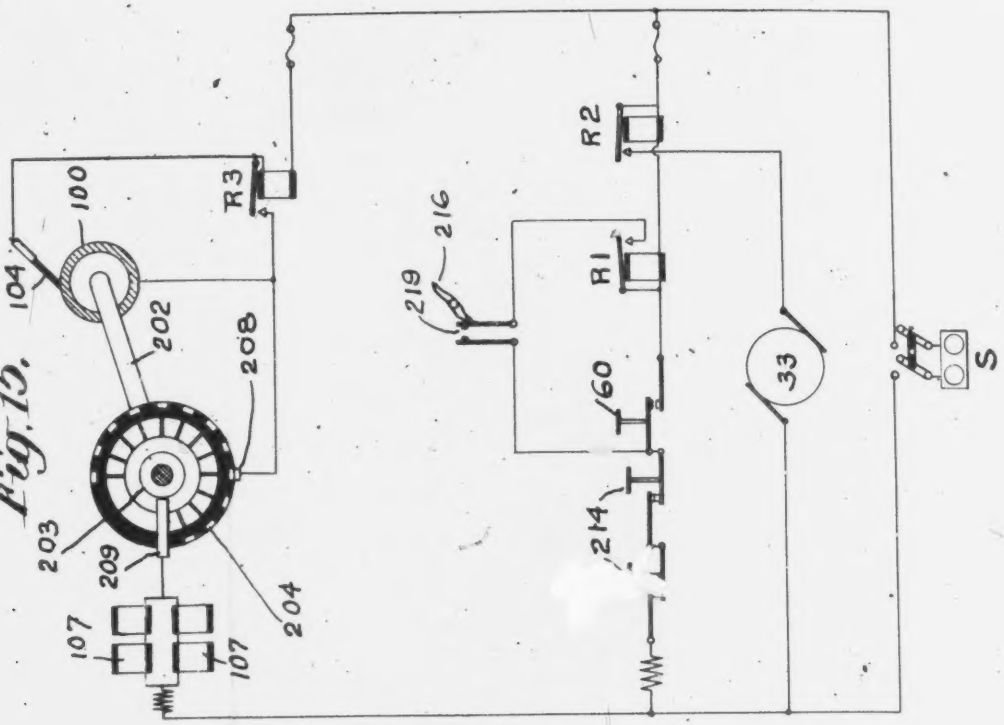

Fig. 15.

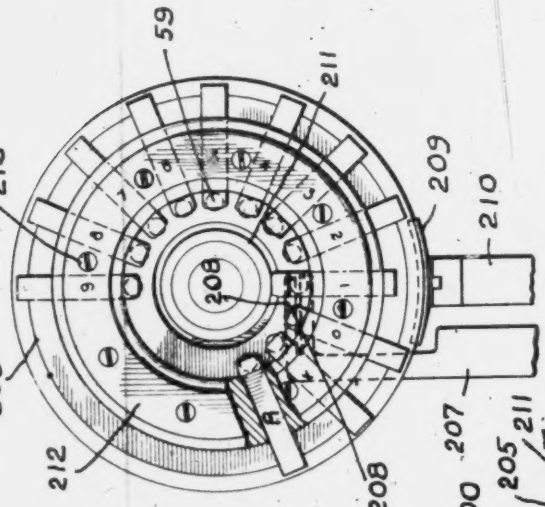

Fig. 13.

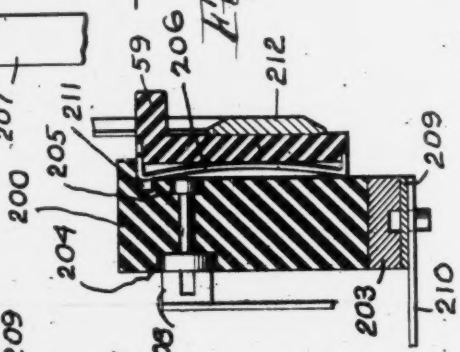

Fig. 14A.

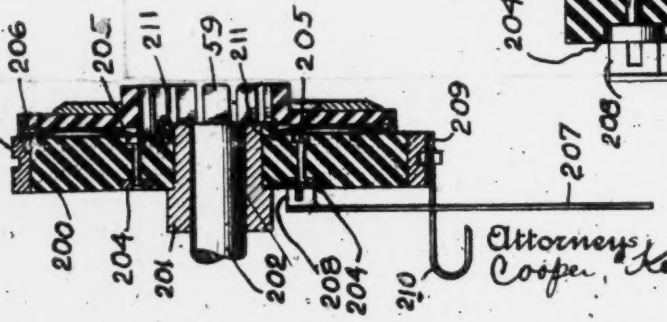

Fig. 14.

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Dec. 31, 1929. E. A. FORD 1,741,985

SORTING MACHINE

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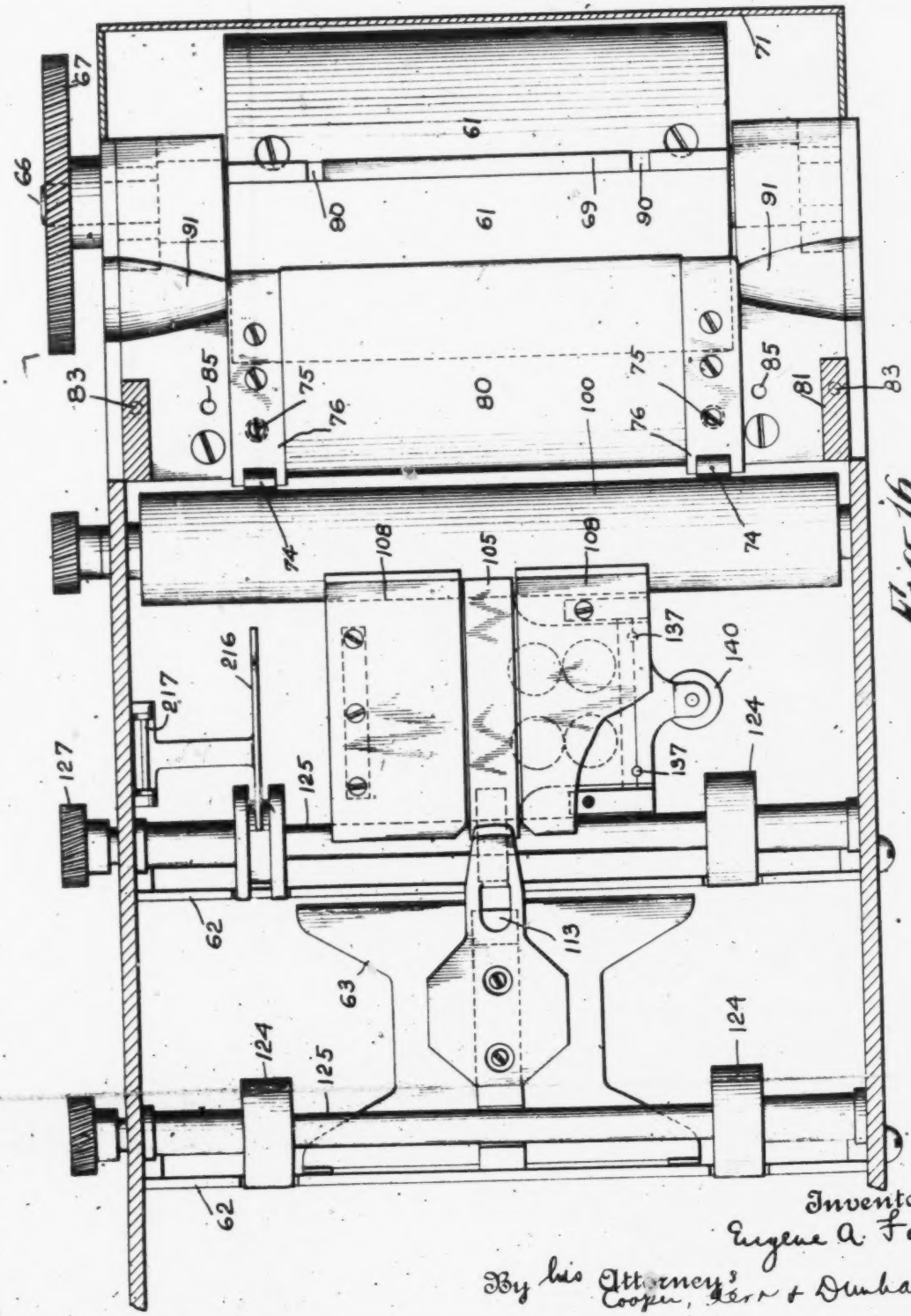

Fig. 16.

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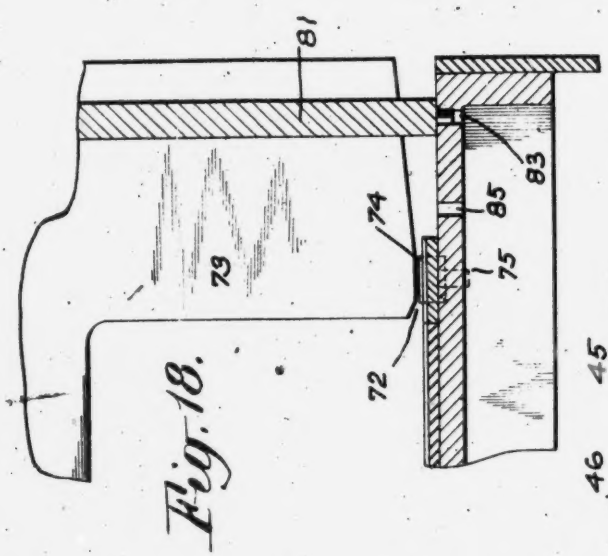

Fig. 18.

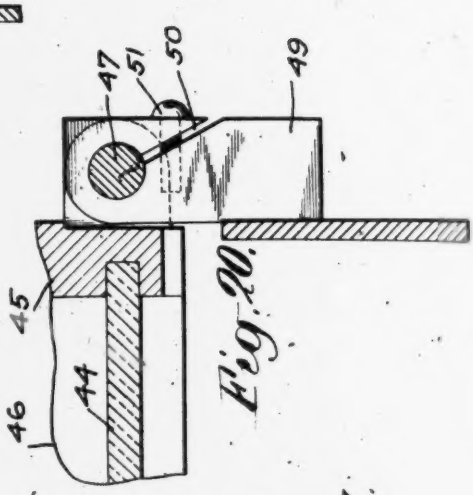

Fig. 20.

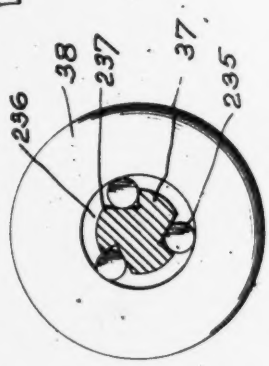

Fig. 19.

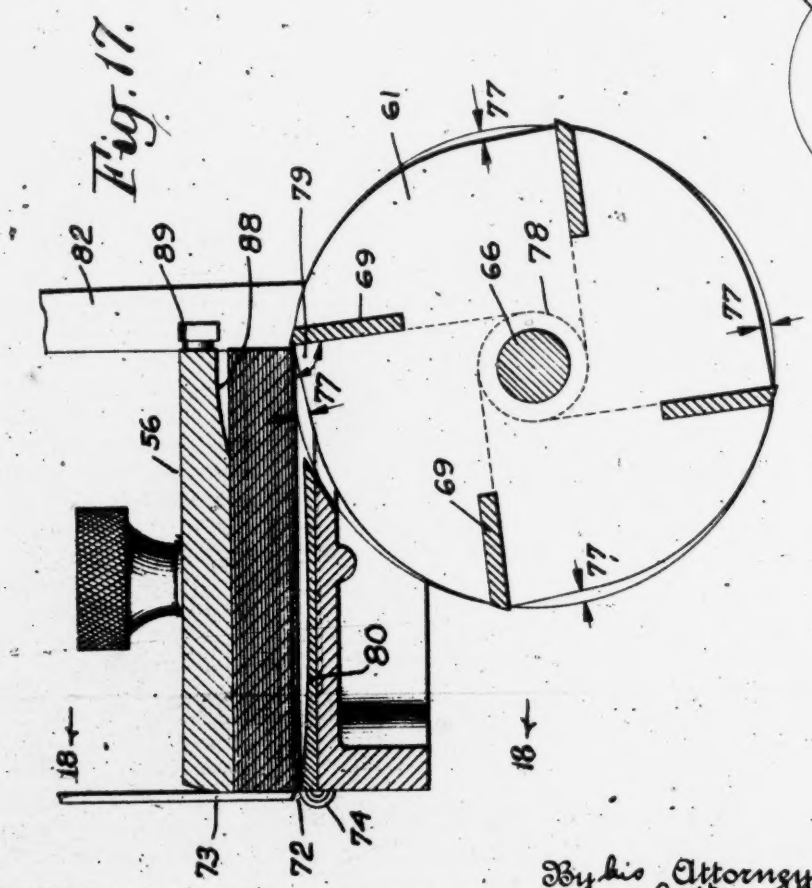

Fig. 17.

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Dec. 31, 1929. E. A. FORD 1,741,985

SORTING MACHINE

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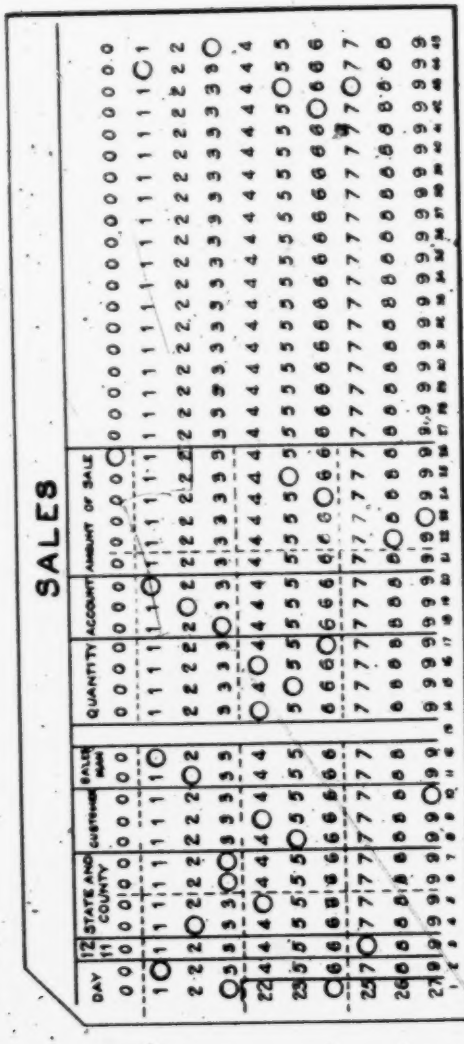

Fig. 21.

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Filed Nov. 7, 1924 11 Sheets-Sheet 11

Fig. 22.

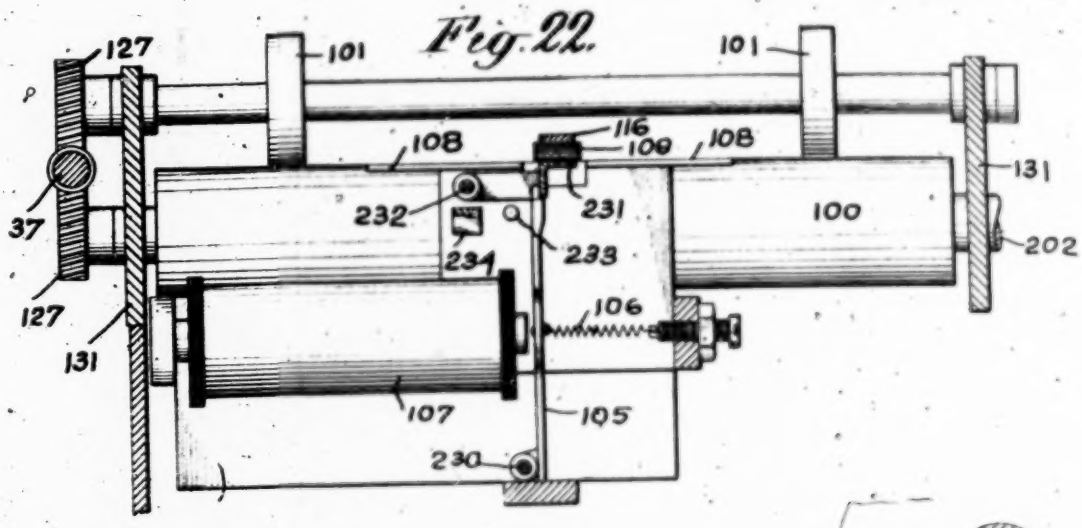
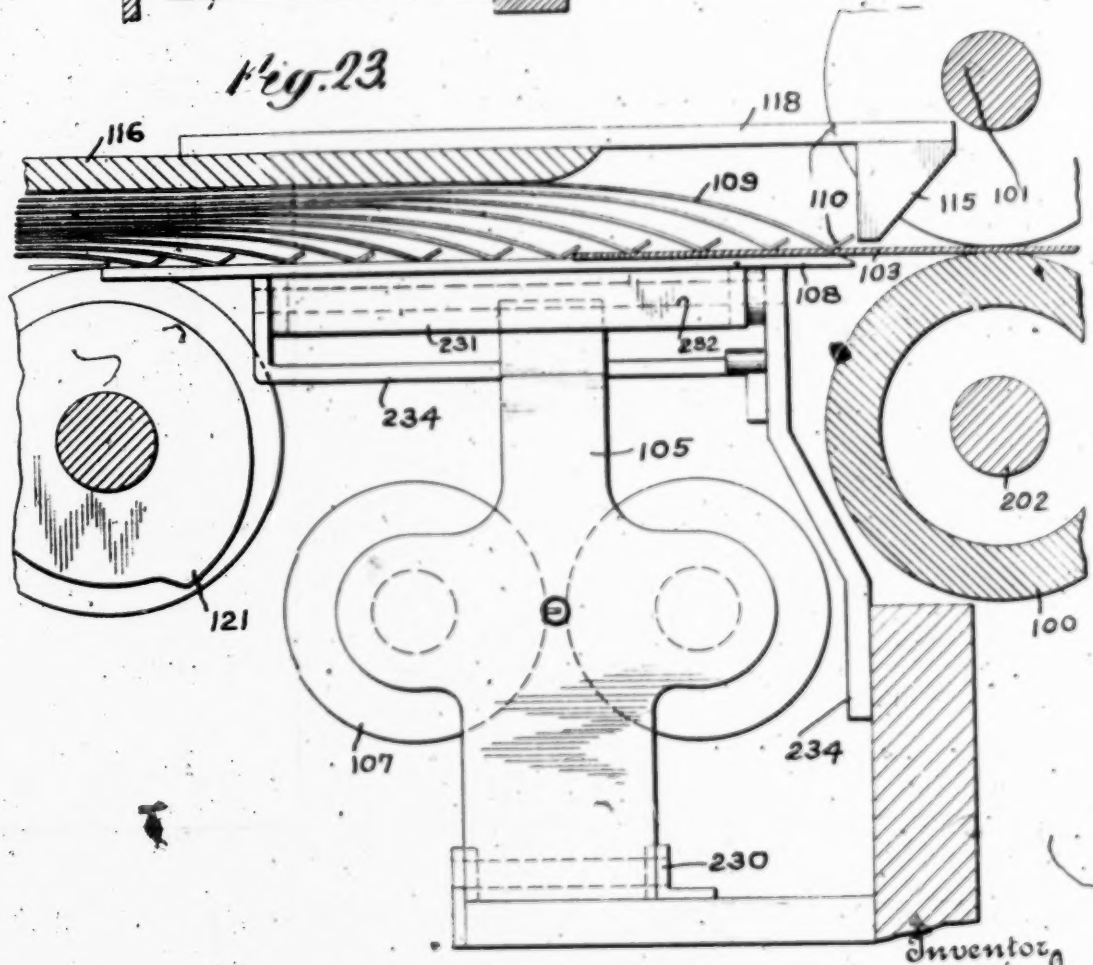


Fig. 23



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UNITED STATES PATENT OFFICE

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SORTING MACHINE

Application filed November 7, 1924. Serial No. 748,347.

This invention relates to machines especially adapted for sorting cards used in tabulating systems such, for instance, as the Hollerith.

Index points are formed by punching holes through the cards, the value and character of the information conveyed by each hole being dependent on its exact location on the card.

The function of the sorting machine is to take a promiscuous stack of cards and sort or classify them into groups as desired by the operator, so as to readily permit the computing or analyzing of the information carried on the cards.

The present invention, which preferably sorts electrically, is designed to overcome many faults of previous sorting machines. It has no reciprocating parts, consequently it may be run at higher speed and with less noise than previous machines. The higher speed enables it to do its work in less time, and the quiet operation allows it to be used in offices where quietness is essential.

Its design and principle of operation is such that it may be built low in height and thereby allow the operator to be seated. Its low height, horizontal construction, and absence of obstructions on top permits the use of a work table as an integral part of the machine, thereby saving the space required by a separate table and adding to the convenience of operation. The card receiving stations being only one tier in height, have greater storage capacity than in former machines.

My machine will handle long or short cards; its brush setting mechanism is more convenient; and its simplicity of construction is such that it is easier and cheaper to build and maintain than former sorters.

In addition to the above, the present machine has universal split and selection, the meaning of which will presently be explained.

One of the objects of the present invention resides in the provision of novel means for effecting the selection of the passages or chutes to the various receiving stations. In place of using a stop element which is controlled by the card analyzing devices for differentially arresting the sorter or distributing blades I provide means whereby the blades are controlled by the card itself thus obviating the use of the stop devices heretofore employed. A further object of the present invention resides in the provision of a card analyzing means for initiating a separation of the blades, which analyzing device operates in conjunction with the record card which is analyzed to control by and in accordance with the position of the card itself the selection of the passage between a pair of blades and thereby determine the destination of the card.

A further object of the present invention resides in the provision of a peculiar form of distributing blades. The blades are provided with receiving ends of progressively different length and the increment of length between each adjacent pair of blade ends corresponds to the interval between adjacent index point perforations of the record cards. Provision is made for directing a card along the blades and at the time the index point is analyzed by the analyzing means provision is made for opening up the blades. The card then acts in accordance with its position to prevent the opening of passages between blades already passed by the card but permits the opening of the next succeeding passage thereby determining the destination of the card.

Further and other advantages of the present invention will hereafter appear in the accompanying specifications and claims and in the drawings, which, by way of illustration, show what I now consider to be a preferred embodiment of the invention.

In the drawings,

Fig. 1 is a front elevation, partly broken away, and partly in section, of my complete machine.

Fig. 2 is a section on line 2—2 of Fig. 1 looking towards the feed magazine and brush mechanism.

Fig. 3 is a section on line 3—3 of Fig. 2.

Fig. 3ª is a detail section of a card discharge receptacle.

Fig. 4 is an enlarged view of the central portion of Fig. 3 showing a card being fed

through the feed rolls at the instant the control magnet is about to operate.

Fig. 5 is the same as Fig. 4 but just after the control magnet has acted.

Fig. 6 is a section as indicated at 6—6 in Fig. 2 showing the automatic card-controlled circuit breaker.

Fig. 7 is a front view, partly in section, of brush holder mechanism, also part of contact cylinder and its shaft.

Fig. 8 is a side view of brush holder mechanism, partly in section.

Fig. 9 is a top view of the receiving end of a distributing blade.

Fig. 9ª is a section side view of the discharge end of a distributing blade, as secured to bracket at receiving station.

Fig. 10 is a plan view of Fig. 1.

Fig. 11 is a section as indicated by 11—11 on Fig. 10, looking to the left.

Fig. 12 is a detail showing how the conveyor rolls are driven.

Fig. 13 is an end view, partly in section, of the universal selector and splitting device.

Fig. 14 is a section on line 14—14 of Fig. 13.

Fig. 14ª is an enlarged detail of the lower portion of Fig. 14.

Fig. 15 is a diagram of the electric circuits, and a diagrammatic representation of the selector mechanism of Figs. 13 and 14.

Fig. 16 is a plan view, partly in section, on the line 16—16 of Fig. 3.

Fig. 17 is an enlarged view, more in detail, of the picker device shown in Fig. 3.

Fig. 18 is a detail on line 18—18 of Fig. 17.

Fig. 19 is a section on line 19—19 of Fig. 3.

Fig. 20 is a view of hinge of work table.

Fig. 21 is a view of a typical record card.

Fig. 22 is a view of an alternative arrangement of control magnet and armature.

Fig. 23 is an enlarged fragmental sectional side elevation of parts shown in Fig. 22.

Record card

In order that the operation of my machine may be fully understood I show in Fig. 21 a typical record card arranged to compile a sales record. Each card represents a sale and when properly punched contains all desired information regarding that particular transaction.

As indicated by the serial numbers across the bottom, the card has 45 columns, and each column has 10 index positions. The columns are arranged in groups, or sections, suitable for the purpose required under each heading.

By way of illustration, columns 21 to 26 inclusive, are provided to record the amount of a sale, which, on the card shown, was $896.50, designated by holes punched in the card at proper index positions. Columns 18 to 20 indicate the account number, which the punched holes show to be 321. Likewise columns 14 to 17 show the quantity, or number of articles sold, to be 4546. The salesman who made the sale was No. 21, as indicated by columns 11–12; the customer was No. 549, as shown in columns 8–10, the sale was made in county 33 in State 24, as shown in column groups 6–7 and 4–5 respectively. Columns 3, 2, and 1 indicate by their punched holes that the sale was made on the 31st of July, 1924.

It will be noted that column 3 has two index points 11 and 12 above the regular ten positions. This is done to be able to handle twelve months in a single column. Two extra index points may be added to any column when required for a special purpose.

The upper portion of column 1 and all of column 2 are used to designate days of the month, and as the highest figure ever required for that purpose is 31, the index spaces below 3 in column 1 may either be left blank or used for some other purpose, for instance, designating the year, as on the card before us. This brings about a condition wherein we have two holes punched in a single column. Such a column is known as a split column and will be referred to again later.

In order to make perfectly clear the function of the sorting machine in my present invention, I shall briefly describe how the record cards are used in actual service.

If the operator has a promiscuous stack of cards covering several years sales, and he wants to know the amount of those sales in dollars and cents, he will run the cards through a tabulating machine, such as the well known Hollerith, which, when adjusted to add the columns 21–26 of the sales card, will register the desired total on suitable counters.

If he wants his sales record divided into years, he will first run his cards through the sorting machine while acting under control of the punched holes in the lower section of column 1, and each year's cards will automatically be discharged into a separate receiving station. Then he can run the cards for each year through the tabulating machine. If he wants the sales for only the year 1922 and is not interested in the other years he can set the control mechanism of my machine so that only the 1922 cards will be separated and deposited in a station by themselves, the remaining cards all going into the "reject" station.

Then if he wants the 1922 sales separated into months my sorter will do it on a separate sorting run while acting under control of index holes in column 3.

If he wants to know the amount of sales to customer No. 549 he will first run all his cards through the sorter and separate out all those having a hole at index position 5 of column 8. This gives him all cards of customers with numbers 500 to 599 inclusive. Then he runs

these cards through the sorter while set for index 4 in column 9, and he then has all cards 540 to 549 inclusive. Finally, he runs this last group under control of the 9 index of column 10 and he then has all the 549 cards, which when run through the tabulator will give the sales to customer 549.

General construction and operation

Having described the purpose of the sorter, I shall now describe its construction and mode of operation.

Referring to Fig. 1 which shows a front view of my machine, the frame 30 is mounted on legs 31. Underneath the main frame, and carried by the legs, is a shelf or subframe 32 supporting the motor 33 which drives the machine by pulley 34 through belt 35 to pulley 36 secured to shaft 37 which runs the full length of the machine, in the rear, pulley 36 being on one end of it and handwheel 38 on the other. Motor 33 is shown slightly displaced from its true position in order to save space in the drawing.

The motor is mounted on a fixed base 39 and has a stem 40 extending into the base, which permits the motor to be adjusted vertically to maintain proper tension in the belt should it stretch, or if the sizes of the pulleys be changed in order to change the speed of the machine. A locking screw operated by handwheel 41 serves to secure the motor to its base.

Box 42 underneath the right hand end of the frame 30 contains the relays, fuses, and electrical connections, current from the outside source being admitted to, or cut out from, the machine by the switch buttons 43.

In handling tabulating record cards it is desirable that they be very carefully stacked or jogged by the operator before being placed in the feed magazine, so as to facilitate their being fed accurately to the machine. My invention provides excellent facilities for this stacking or jogging operation, in the table top 44 (Figs. 1, 10, 11, 20) with its back 45 and its ends 46 all arranged at right angles to each other. The table is preferably of transparent material such as glass, so the progress of the cards moving underneath to their respective stations may be observed. The table-top is hinged by the rod 47 secured to an extension 48 of the top, at each end, the rod 47 passing through a plurality of clamps 49 which are slotted, as at 50, and adjusted by screws 51 to give just sufficient grip on shaft 47 to retain the top at any desired raised position and prevent its slamming down. If desired, the top may be clamped down by the thumb screws 52 which serve to secure the top to the guard plate 53 which extends lengthwise of the machine in front and is rigidly attached thereto. The plate 53 has several cut-away portions, as at 54 (Fig. 1) for convenience of the operator in getting his fingers under the top to raise it.

A group of cards having been properly stacked, the stack is placed in the feed magazine as at 55 with plate 56 on top of the stack. This plate is used so that when there are only a few cards left in the stack there will be enough weight on them to prevent them being displaced from true position by the rapid action of the picker mechanism. Bracket 57 serves to hold the plate when it is not in use.

The operator by means of a crank handle 58 moves the contact brush so it will traverse the desired index column on the cards as they pass under it, and he arranges the selector buttons 59, to give the kind of sort he wants. He then starts the machine by depressing button 60. Picker drum 61, driven from shaft 37, rotates and feeds the cards one by one from the bottom of the stack into the analyzer, whence passage of each card is directed between succeeding pairs of conveyor rolls into one of the thirteen receiving stations R, E, X, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9.

Each receiving station consists of a compartment formed by the vertical walls 62, in which is an inclined tray 63 having vertical fingers 64 (Fig. 3[a]) extending upwardly from its lower edge. Each tray is carried by a plunger 65 which extends downwardly into a cylinder 66, wherein the plunger is supported by a coil spring 67 of such resiliency as to gradually sink as its load of cards increases and always maintain the top of its stack at or near the top of its compartment so that newly arriving cards will have only a slight distance to drop and consequently will have no chance to turn over or become otherwise deranged.

Feed mechanism

The feed mechanism (Figs. 2, 3, 16, 17, 18) consists of the rotary picker drum 61, mounted on shaft 61[a] on which is fast spiral gear 67 driven by worm 68 on shaft 37. Drum 61 carries in its rim a number of picker blades 69 extending lengthwise of the drum and secured in place by the screws 70. These blades project from the drum a distance slightly less than the thickness of a card. Picker drum 61 is enclosed in the housing 71. As the drum revolves each blade in turn picks a card from the bottom of the stack 55 and feeds it through the micrometer or card throat openings 72 provided between the fixed plates 73 and rollers 74, carried by plates 76, one micrometer opening being located toward each end of the card. The openings are adjusted so that only one card may pass at a time, the adjustment being accomplished by set screws 75 which raise or lower plates 76 thereby moving rollers 74 relative to plate 73. The card is impelled by the picker blade until it is seized by the contact cylinder and its rollers.

The picker drum varies from true cylindrical shape as best shown in Fig. 17 wherein it will be noticed that after a picker blade has taken its card, the weight of the right hand side of the stack of cards is resting on that portion of the drum which is truly cylindrical, and as the drum revolves, the stack, following the cut-away contour of the drum, gradually reaches a low position at the point 77, from which point the edge of the stack is rapidly pushed upward again as that portion of the drum between 77 and the blade pass under it, and is still being raised when the blade contacts with the card.

The front faces of the blades are not radial, but if extended inwardly would be tangent to the circle 78. This is done so there will be a slightly obtuse angle between card and picker blade at time of contact as indicated by angle 79, and the blade thereby gets a positive grip on the card.

Each card, when struck by the rapidly moving picker blade, has a tendency to buckle, but this is rendered unobjectionable by making plate 80 slightly concave. This construction allows the card to buckle slightly downwards in the middle without disturbing the stack or interfering with the positiveness of feed. Likewise the lower edges of plate 73 are curved upwards on both sides of micrometer opening 72 to allow the card freedom to curve slightly at its ends without interfering with regular operation of feed.

The stack of cards is held in position to be fed into the machine by plate 73 and by the two end plates 81 and by the two slotted posts 82. The end plates 81 are held in position by dowel pins extending from their lower ends into the frame of the machine, as at 83, and by thumb screws 84 through the plate 73 near the upper ends of the posts. Provision may be made for feeding cards of different lengths by moving end plates to different positions, as for instance, to the positions indicated by dowel holes 85 in the frame and thumb screw holes 86 in plate 73. Posts 82 are slotted vertically to receive guide studs in keeper plate 56 as indicated at 87 (Fig. 3).

The under side of plate 56 (Fig. 17) is slightly cut away as at 88 to prevent the picker knives hitting the edge of the plate after the last card has been fed. To further provide against injury to plate or blades the plate is provided with two studs 89, their lower edges being lower than the bottom of the plate so that when the last card has been fed the heads of the studs ride on the drum and keep the plate out of contact with drum or picker blades. The blades are cut away at points 90 (Fig. 16) to provide a clear path for the studs 89. The cut-away portions 91 in frame are to provide finger clearance when handling stacks of cards.

Distributing system

The principle of my distributing system may be readily understood from Figs. 4 and 5, in which 100 is a brass contact cylinder extending crosswise of the machine, 101 being a pair of rollers pressed downwardly against cylinder 100. 103 is a card passing between cylinder and rollers, and 104 is the brush carrying electric current. 105 is a hinged armature normally held by spring 106 (Fig. 2) in elevated position as in Fig. 4, but drawn down to position as in Fig. 5 when the magnets 107 are energized. 108 are sheets of insulating material, such as bakelite, one on each side of the upraised end of the armature. 109 are a plurality of flexible blades made of steel and spring biased downwards so their upturned tips 110 rest on top of armature 105. The receiving ends of the blades are narrowed relatively to the main portions of the blades, as shown in Fig. 9. The other ends of these blades are successively attached to brackets 111, one above each receiving station, the lowest blade going to station R, the second from the bottom going to station E, the third to station X, the fourth to station 0, the fifth to station 1, and so on to station 9.

The method of attachment to the brackets 111 is shown in Fig. 9ª which shows the main body of the blade welded to block 112 which is attached to bracket 111 by screws. A portion 113 punched from the center of the blade is bent downwardly below the bracket 111. A separate chute deflecting blade 114 is secured to each bracket 111 to assist in stacking the cards properly in the several receiving stations. 115 is a guide block to insure the cards properly entering between plates 108 and spring lips 110, while 116 is a rigid plate extending lengthwise of the machine above the blades 109. It is fastened to the frame above station 9 and by cross members 117. It carries guide block 115 on arm 118 which is secured to 116 by screw 119 and dowel pin 120 so when desired it may readily be swung aside.

Restoring cam 121, revolving synchronously with the balance of the mechanism, restores the armature 105 to its position after the passage of each card.

In passing to the several receiving stations the card is drawn along between successive upper and lower pairs of feed rolls spaced so that each set of rolls receives the card before it has passed completely from the preceding set. All rolls are positively driven. The upper rolls are 122, fast on shafts 123, while the lower rolls are designated 124, fast on shafts 125. The rolls are all of the same diameter and driven at the same speed, shafts 123 and 125 being driven from shaft 37 by worms 126 meshing with spiral gears 127 secured to ends of the roller shafts. The upper rolls turn clockwise and the lower ones

counter clockwise so as to draw the cards between them. The rollers are placed on their shafts so as to be in line with the card throat openings 72.

Lower roller shafts 125 (see Fig. 11) run in sleeves 128 which have their ends fitted into round holes in the frame of the machine and serve as bearing and spacing collars for the shafts. On the upper roller shaft 123 the hub of the gear 127 serves as a spacing collar on one end and with collar 129 on the other end, keeps the shaft in proper endwise position. Grooved sleeves 130 serve as bearings for this shaft. These bearing sleeves fit into slots in frame plates 131 (Fig. 1). The slots are open on the top so the bearing sleeves may be slipped in from above. The sleeves are held snugly by the sides of the slots but do not touch the bottoms of the slots, thereby allowing the upper pairs of rollers 122 to rest on lower pairs 124. The degree of pressure between the upper and lower rolls is adjusted by the spring clips 132 which have two downwardly bent ends, one end resting on top of frame 131 while the other rests in the groove of bearing sleeve 130. It is evident that the downward pressure on 130 may be adjusted by regulating screw 133 which passes through the middle portion of clip 132 and secures it to the frame 131. The shield 134 extends lengthwise of the machine to cover shaft 37 and the gears 127.

While the machine is sorting a promiscuous stack of cards, each card as it comes from the feeding mechanism is passed over the cylinder 100, with brush 104 bearing on the top surface of the card. If the brush finds no hole in the card, that card will pass along above plates 108 and underneath all the upturned blade ends 110, into the first receiving station, designated R, or "reject".

If, however, brush 104 finds a hole in the card it will complete the electric circuit by making contact with cylinder 100, magnets 107 will thereby be energized, armature 105 will be drawn down, followed by all the blade ends 109 which are not prevented by the card itself from following the armature, and we have the condition shown in Fig. 5 wherein it is evident that further progress of the card to the left will direct it into the passage between the 5th and 6th blade (counting from the right), and that card as it passes between the successive pairs of rollers will be confined to that particular passage, which ends in station 4. It is evident that the destination of each card depends on how far the card has traveled underneath the blades 109 at the instant the magnet is energized, and that depends on the location of the hole in the card.

The cards are fed bottom first and the brush passes over the index postions in any column in the order 9, 8, 7, 6, 5, 4, 3, 2, 1, 0, followed by the extra positions, as for instance 11 and 12 in Fig. 21. These extra positions correspond to stations X and E respectively.

Ends 110 of blades 109 are so positioned relatively to the brush 104 that if the brush finds a hole at index position 9 the magnet will have acted before the advancing edge of the card has reached the first blade, the card will pass above all the blades and will be conducted by the rollers into the furthest station, which is No. 9. If the brush does not find a hole in the card until index point 8 is reached, the card will have advanced far enough to prevent the end of the first blade being lowered when the magnet is energized, but all the others will have followed the armature downward (both on account of the spring bias of the blades themselves, and the attraction of the magnets for the blades, which are preferably of steel) and the card will pass between the first and second blades into station No. 8, and so on. It will be understood that the thickness of the blades is much less than indicated by the drawings, so they must bend only very slightly in order to permit the cards to travel in the plane between the rolls.

Armature 105 is a swinging plate (Fig. 2) above the four magnets 107 which are mounted in the frame 135. The armature is hinged by a V shaped pivot formed on top of one of the sides of the magnet frame 135, at 136. Two pins 137 set into the top of the wall, pass loosely through holes in the armature and prevent it being displaced. Spring 106 may be adjusted by screw 138 passing through stud 139 and locked by nut 140, to hold the armature in its elevated position against the pressure of blades 109. The armature is formed, at its end adjacent the blades, into the shape of a plate approximately the width of blades 109, and located between insulating plates 108.

Brush mechanism

Brush 104 is secured by any suitable means to brush plate 150 (Figs. 7 and 8). The brush plate is fastened by screws or rivets 151 to brush holder 152 which is bakelite or some similar insulating material. Plate 150 is slotted as at 153, to provide a tongue 154 which makes a resilient contact with the current-carrying plate 155 extending cross-wise the machine. Steel plate 157 extending crosswise the machine is secured thereto at its ends, and has a serrated upper edge, each notch corresponding to a column on a card. Secured thereto is the angle member 158 which bears on its upper side, numbers from 1 to 45, corresponding to the columns on the cards. Screw 159 extends crosswise the machine and is turned manually by crank 58 to move the brush holder, by threaded block 160, to its desired position. Set into block 160 and held by plate 161 is the piece 162 which has an upwardly extending arm 163 having a projection at its upper end, this projection being

V-shaped on its under side to fit any one of the serrations on the upper side of bar 157. The lower part of member 162 has stepped shoulders extending laterally, the lower steps 164 (Fig. 7) serving as guides to keep 162 in position, and the upper steps 165 serving as bearings for the coil springs 166, set into recesses in 160, and which through plungers 173 press 162 constantly downwards relatively to 160. Pin 167, screwed into the rear of the lower part of 162, serves to carry block 152. Pin 167 is provided on its lower side with a milled recess or keyseat crosswise of the pin while block 152 is provided with a semicircular key which when rotated by its handle 170, enters recess 168 and locks 152 on pin 167.

When screw 159 is turned by crank 58 to move the brush mechanism crosswise of the machine so that brush 104 will register with the desired column on the card it is essential that the brush be not injured by being dragged sidewise on the card or on cylinder 100, and the above described mechanism prevents such injury. Fig. 2 shows the brush in operative position with V shaped projection 163 resting in the bottom of the serration in bar 157 corresponding to the card column being analyzed. Block 162 is spring pressed to its lowest position. If now screw 159 be turned the inclined face of the V tooth on bar 157 acting on the V shaped projection 163 will raise the latter and with it the brush to the position shown in Fig. 7. If the screw be turned further 163 will settle into the next notch, and if turned still further the brush may be moved as far as desired across the card, the brush rising at each tooth but never dragging.

As a further precaution against injury to the brush while being removed for inspection it will be noticed that brush holder 152 has a downwardly projecting shoulder 171 engaging with a shoulder 172 on member 156 so that brush holder 152 can not be removed from nor replaced on pin 167 until 152 is in its highest position and the brush therefore out of contact with card or cylinder 100.

Selector mechanism

The selector is a device designed to enable the operator of the sorter to determine which index holes in a card column will control the sort.

My selector (Figs. 13, 14, 14ª) comprises a circular disc 200 of bakelite or some similar non-conducting material, mounted on a metal hub 201 which in turn is fast to shaft 202 which carries cylinder 100. Disc 200 has an outer rim 203 of copper or brass, and near its hub has a ring of brass or copper buttons 204 embedded flush with the bakelite surface. Each button corresponds to a sorting station and is lettered accordingly R, E, X, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. Each button 204 is connected by a rivet through the disc to a button 205 on the other face of the disc 200.

Slidable radially in conjunction with each contact button 205 is a bow-spring 206, each being manually movable by its bakelite thumb button and retainer 59.

Electric current comes to the selector through conductor 207 and brush 208. As disc 200 revolves each contact button 204 in turn contacts with brush 208 and if at the instant such contact is made the spring 206 is set at its outermost radial position, as in the upper part of Fig. 14, then its outer end will be in contact with ring 203 and the circuit will be complete through the selector, the current passing out through shoe 209 and conductor 210. If, however, any button 59 is pushed, with its spring 206, to the inner limit of its travel, as for instance the No. 1 button in Fig. 13, a condition is found as best shown in the enlarged cross section in Fig. 14ª wherein it will be noticed that spring 206 makes contact with neither the button 205 nor the outer ring 203 and no current passes. In this position the bow-spring 206 automatically locks itself in position when its inner end enters the circular groove 211.

The rotation of the selector is so timed with relation to the movement of the cards being fed into the sorter that each selector button makes contact with brush 208 just before the corresponding index position on the card reaches brush 104. Then if the brush finds a hole in the card at that index position it makes contact with drum 100, the magnets 107 are energized and the card goes to its proper station as previously described. It will be noted that contact must be made concurrently by brush 104 and brush 208 in order to energize the magnet. In actual practice contact is made and broken by brush 208 slightly before being made and broken by brush 104, in order to prevent sparking at the card.

The diagram (Fig. 15) illustrates the flow of current, the upper portion representing in perspective shaft 202, a portion of cylinder 100 and the selector mechanism arranged, for convenience of illustration, with ring 203 and its brush near the hub, and buttons 204 and brush 208 on outer rim. A retaining ring 212 held to disc 200 by screws 213 holds bow-springs 206 and buttons 59 in position.

Operation

In "straight" sorting all buttons 59 are pushed out so the circuit is completed through the selector as each button 204 contacts with brush 208 and the sort is under entire control of brush 104 and the cards therefore will all be sorted into their respective stations in accordance with locations of index holes in the column being analyzed.

To "split" the column at any desired point, as for instance if the operator wants to re-

ject all cards having perforations below the three position in a column, he will push in all the 4, 5, 6, 7, 8 and 9 buttons. Then all cards having holes in those positions will be rejected while all cards having holes 3 and above will be sorted to their respective stations. This feature proves useful in a column such as No. 1 in Fig. 21 in which there are two holes in each column, those below 3 denoting years and those in positions 3 and above denoting days of the month, as it allows each section of the column to be sorted separately.

The device may be used also for selecting only cards having holes punched at only one index position, as for instance the 6 position, in which case all buttons except the 6 will be pushed in. All 6 cards will then go to the 6 station, the others all going to the R station.

To sort more than one position in a column, as for instance 9 and 7, all buttons except 9 and 7 are pushed in. Then all cards with only a 9 hole will go to the 9 station and all with only a 7 will go to the 7 station, all others being rejected. If it happens that a card has holes at both 9 and 7 positions it will go to the 9 station because the 9 index position reaches brush 104 first. The cards in 9 station therefore will have to be run through the sorter again with only the 7 button in control, in order to separate them.

In ordinary service the operator starts the machine by pressing starter button 60 and stops it by pressing either of the stop buttons 214, one at each end of the machine. To maintain the motor in operation and allow the operator to release pressure from the start key after cards are started feeding through the machine and further to automatically stop the motor upon the passage of the last card a card lever contact or switch mechanism is provided. After a card has passed the cylinder 100 and before reaching the first pair of conveyor rollers it passes beneath the block 215, fast to the frame of the machine, thereby depressing card lever 216 which is pivoted to the frame at 217, and which by its downwardly extending arm 218 controls the card contacts 219. When a card is passing arm 218 presses spring blade 220 to the left and contact is maintained at 219, but if no card is passing, 216 is free to rise sufficiently to allow 218 to move to the right, and spring blade 220 breaks the contact. Rollers 122 and 124 immediately adjacent this automatic switch mechanism are grooved to accommodate the heel of card lever 216.

In starting the machine start key 60 is depressed closing a circuit from source S through control relay R^1, motor relay R^2 and back to source. The energization of relay R^2 brings the motor 33 into circuit with the source S. After the cards begin to pass contacts 219 closes and maintain relay R^1 energized until its circuit is broken by the depression of either of the stop keys 214 or by the opening of card lever contacts 219 after the passage of the last card or upon the failure of feeding of a card into the machine. Relay R^3 is closed upon the passage of an index point perforation under the brush 104 and thereafter establishes a circuit to contact brush 208 and thus permits a reduction in the amount of current which flows through the brush circuit, the main supply for the sorter magnet 107 passing directly from relay R^3 and not passing through brush 104.

Figs. 22 and 23 illustrate an alternative arrangement of the control magnets in which the magnets are horizontal instead of vertical, with armature pivoted at 230. When the magnets are energized and armature 105 drawn to the left, it releases angle piece 231, which, swinging on its pivot 232 drops until it rests on stop pin 233 thereby permitting the spring-biased ribbons 109 not supported by the card, to drop and direct the card between the proper pair of ribbons to its station. The hinge 232 is supported by the frame 234 fast to the frame of the machine. As 231 is restored to its normal position by cam 121, armature 105 influenced by spring 106 latches 231 in raised position where it remains until the magnet is again energized.

It is sometime desired to operate the machine slowly by hand, and for that purpose hand wheel 38 is provided on the end of shaft 37. This hand wheel is provided with a one-way clutch so as to prevent turning the machine in the wrong direction and thereby injuring the brush. This clutch has rollers 235 contained within the cylindrical hub and acting in conjunction with inclined surfaces 237 so that if wheel 38 be turned clockwise, shaft 37 will also turn, but if 38 is turned counterclockwise shaft 37 will not be moved.

In accordance with the provisions of the patent statutes, I have herein described the principles of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof, but I desire to have it understood that the apparatus disclosed is only illustrative and that the invention can be carried out by other means. Also, while it is designed to use the various features and elements in the combinations and relations described, some of these may be altered and others omitted and some of the features of each modification may be embodied in the others without interfering with the more general results outlined, and the invention extends to such use.

I claim:

1. In combination, means for analyzing a card, a plurality of distributing passages the receiving ends of which are normally closed, means operated by said analyzing means to open the receiving end of a passage for the card, the position of the card itself determining which passage shall be opened.

2. In combination, analyzing means comprising devices which cause electric energy to pass through holes in the card, a plurality of distributing passages, a magnet controlled by said analyzing means to open the receiving end of a passage for the card, the position of the card itself determining which passage shall be opened.

3. In combination, analyzing means comprising devices which cause electric energy to pass through holes in the card, a plurality of blades, a movable member under control of said analyzing means, said movable member operating in conjunction with said card to open a passage for the card between the blades.

4. In combination, analyzing means comprising devices which cause electric energy to pass through holes in the card, a plurality of blades forming passages for cards, a movable member under control of the analyzing means, the receiving ends of said blades being spring biased against said movable member, said movable member operating in conjunction with the card to open a passage for the card between the blades.

5. In combination, analyzing means comprising devices which cause electric energy to pass through holes in the card, a plurality of blades forming passages for cards, an armature movable by said analyzing means, the receiving ends of said blades resting on said armature, and said armature operating in conjunction with the card to open a passage for the card between the blades.

6. In a card sorting machine, in combination, a feeding device, an analyzing device comprising means for causing electric current to flow through holes in the card, a plurality of receiving stations, a plurality of blades forming passages for cards, an armature movable by said analyzing means, the receiving ends of said blades resting on said armature, the armature operating in conjunction with the card to open a passage for the card between the blades.

7. In combination, an analyzing device comprising means for causing electric current to flow through holes in the card, a magnet operable by said analyzing device, a plurality of superimposed blades forming distributing passages for the cards, the receiving end of each of said blades being longer than the one below it, and all said blade ends resting on a plate so positioned that said card while emerging from the analyzing devices passes between said blade ends and said plate, means for bringing about a lowering of said plate and all of said blades except those superimposed upon the card being analyzed upon the analyzation of a card to thereby open a passage for the card between two blades, the particular passage opened depending upon the position of the card at the instant of lowering the blades.

8. In an apparatus of the class described, in combination, card analyzing means comprising devices which cause electric current to flow through holes in the card, a magnet controlled thereby, a plurality of superimposed blades of magnetic material forming distributing passages for the cards, the receiving end of each blade being longer than the blade below it, a movable armature upon which the receiving ends of said blades rest, means for directing the analyzed cards between said armature and the receiving ends of said blades, said magnet when energized under control of the analyzing means attracting said armature and with it all blade ends not arrested from descent by the card itself whereby a card passage is selected between two blades, which selection of passage depends upon the position of the card itself as the analyzing is effected.

9. In apparatus for sorting cards under control of electric currents flowing through holes in the card, in combination, a contact brush, and means to position said brush relatively to a card, said positioning means being arranged to prevent contact of said brush while such relative motion is taking place.

10. In apparatus for sorting cards under control of electric currents flowing through holes in the card, in combination, a contact brush, a brush holder, means to position the brush relatively to a card, said positioning means comprising a serrated bar coacting with the brush holder to raise the brush out of contact during such relative movement of the brush.

11. In apparatus for sorting cards under control of electric currents flowing through holes in the card, in combination, a contact brush, a brush holder, a serrated bar, means comprising a screw to position the brush relatively to a card, said serrated bar coacting with said brush holder to raise the brush out of contact during such relative movement of the brush, and lower said brush into contact at every card column.

12. In apparatus for sorting cards under control of electric currents flowing through holes in the card, in combination, a contact brush, a brush holder, a serrated bar, means comprising a screw to position the brush relatively to the card, said serrated bar coacting with the brush holder to hold the brush out of contact during such relative movement of the brush, and lower the brush into contact at a position corresponding to each column of the card.

13. In apparatus for sorting cards under control of electric currents flowing through holes in the card, in combination, a contact brush, and means to prevent removal or replacement of the brush while said brush is in contact.

14. In apparatus for sorting cards under control of electric currents flowing through

holes in the card, in combination, a contact brush, a brush holder, a fixed cross member, said brush holder interlocking with said cross member to prevent removal or replacement of the brush holder while the brush is in contact.

15. A sorter of the horizontal type having a plurality of receiving stations disposed side by side in horizontal alignment, conveying and card distributing devices above said stations, and a card jogging table disposed above said conveyor and distributing devices, said table having a transparent portion to permit the operator to inspect and view the progress of the cards through the distributing devices under the action of said conveyor.

16. A sorter of the horizontal type having a plurality of receiving stations disposed side by side in horizontal alignment, conveying and card distributing devices above said stations, and a card jogging table disposed above said conveying and distributing devices and supported for displacement from normal position to render the conveying and distributing devices and any cards contained therein accessible to the operator.

17. The invention set forth in claim 16 in which said table is provided with a transparent portion to permit the operator to note the progress of the cards through the distributing devices while said table top is in normal position, and in which automatic means is provided to hold said table top in any displaced position to prevent damage to the machine or injury of the operator.

18. In a card sorting machine, which includes card analyzing means and means for conveying cards to different stations according to analysis thereof, a receptacle at one of said receiving stations comprising vertical walls, and between said walls a resiliently supported inclined tray, said tray having fingers extending upwardly from its lower edge to arrest and support the cards out of contact with the walls of the receiving chamber.

19. In a card sorting machine, which includes card analyzing means and means for conveying cards to different stations according to analysis thereof, a receptacle at one of said receiving stations comprising vertical walls, and between said walls a tray carried on a stem guided by a vertical tube telescoping with said stem and resiliently supported in said tube.

20. In a card sorting machine, in combination, a feeding device, an analyzing device, a plurality of receiving stations and means controlled by the physical structure of the card itself and apart from the cooperation of portions of the card with said analyzing device, for determining to which station the card will be delivered.

21. In a card sorting machine, in combination, a feeding device, an analyzing device comprising means for causing electric current to flow through holes in the card, a plurality of distributing passages, a magnet controlled by said analyzing device to open the receiving end of a passage for a card, the position of the card itself supplemented by the control from said analyzing device for determining which passage will be opened.

22. In a card sorting machine, in combination, a card picking device, an analyzing device receiving cards therefrom, a plurality of receiving stations, and a distributing system comprising a plurality of blades forming passages for the cards from the picking and analyzing device to said stations, said blades being attached to frame of the machine only at their discharge ends.

23. In a card sorting machine, in combination, a picking device, an analyzing device receiving cards therefrom, a plurality of receiving stations, a distributing system comprising a plurality of blades forming passages for cards, and a conveyor having feed rolls disposed at each side of said distributing blades, said blades being free of any support at the marginal sides thereof throughout their length.

24. In a card sorting machine, in combination, a card picking device, an analyzing device, a plurality of receiving stations, a distributing system comprising a plurality of passages for cards, means controlled by the direct cooperation of a card and an element of the distributing system to select the passage for the card therein, and a conveyor arranged to convey such card from the picking and analyzing device through the distributing system in the passage selected by the card itself.

25. In a card sorting machine, in combination, a card feeding device, an analyzing device receiving cards therefrom, a series of horizontally disposed receiving stations, a card conveyor common to all said stations and located above said stations, a distributing system having passages through which cards are conveyed by the conveyor from the analyzing device to the stations, and means controlled by the direct cooperation of a card with elements of the distributing system and in turn controlled by the analyzing device for selecting the passages in said distributing system through which the card is conveyed.

26. In a card sorting machine, in combination, a card picker device, an analyzing device, a series of horizontally disposed receiving stations, a card conveyor common to all the stations and located above them, and a distributing system having passages through which cards are conveyed by the conveyor from the analyzing and picking device to the stations, said distributing system comprising members extending from ad-

jacent the analyzing members to the receiving stations and being independent of any lateral support throughout their length thereby permitting the conveyor device to engage both edges of the cards and advance the same to their stations without interference.

27. In a card sorting machine, in combination, a card feeding device, an analyzing device, a plurality of horizontally disposed receiving stations, a card conveyor comprising successive sets of rolls and common to all said receiving stations and located above them, and a distributing system comprising blades through which cards are conveyed by the conveyor from the analyzing and feeding device to the stations.

28. In a card sorting machine, in combination, a card magazine, an analyzing device, a card feeding device for feeding cards from the magazine to the analyzing device, a plurality of horizontally disposed receiving stations, a conveyor receiving cards from the analyzing device and common to all said stations, a distributing system comprising a plurality of passages formed by blades extending to said stations and means for controlling the opening of the passage through which a card is to pass, said means comprising the card which is sorted operating directly upon the blades of the distributing system.

29. In a card sorting machine, in combination, a card magazine, a feeding device, an analyzing device receiving cards therefrom, a plurality of horizontally disposed receiving stations, a conveyor common to all said stations to convey the cards thereto from the analyzing device, and a distributing system comprising a plurality of passages formed by blades, through which passages each card is conveyed to one of said stations, the particular station being determined by the card itself coacting with the blades of the distributing system while passing through the analyzing device.

30. In a card sorting machine, in combination, a plurality of distributing blades, means for successively feeding record cards into cooperation with said blades, said blades having their receiving ends arranged in progressively decreasing length, the increment between each adjacent pair of blades corresponding to the interval between the index point positions of the record cards, means for effecting a separation of the blades, means controlled by the card for determining which blades shall be separated and card analyzing means for controlling the time of such separation.

31. In a card sorting machine, in combination with a plurality of distributing blades, means for successively feeding record cards into cooperation therewith, said blades having their receiving ends arranged in progressively decreasing length, the increment between each adjacent pair of blade ends corresponding to the interval between the index point positions of the record cards, card analyzing means and means controlled thereby for effecting an opening of the blades, said opening being effected upon the particular blades according to the position of the card relative to said blades.

32. In a card sorting machine in combination with a plurality of distributing blades, means for successively feeding record cards into cooperation therewith, said blades having their receiving ends arranged in progressively decreasing length, the interval between each adjacent pair of blade ends corresponding to the interval between the index point positions of the record cards, card analyzing means and means for effecting a selected opening between the blades, said means being controlled conjointly by the analyzing means and the position of the card relative to the receiving ends of the blades.

33. A card sorting machine comprising in combination, separable distributing blades and means comprising the card which is to be distributed by said blades for directly controlling by the cooperation of the card and blades the selective separation of said blades.

34. A card sorting machine comprising in combination, separable distributing blades and means comprising the card which is to be distributed by said blades for directly controlling by the cooperation of the card and blades the selective separation of said blades, and analyzing means for the record card having provisions for initiating a separation of such blades as are selected by the card.

35. A sorting machine comprising a plurality of sorter blades, said blades having their receiving ends of progressively decreasing length, each blade end having an upturned end to guide the card past the blade end, means for directing a card along and in contact with the blade, and means for effecting an opening of said blades to form a passage between certain blades.

36. A sorting machine comprising a plurality of sorter blades, said blades having their receiving ends of progressively decreasing length, each blade end having an upturned end to guide the card past the blade end, means for directing a card along and in contact with the blades, means for opening the blades at a time depending upon the index point position of the cards, said card acting to arrest the opening of the blades already in contact with the card whereby the card enters a passage between the last arrested blade ends and the first unarrested blade.

37. In a card sorting machine, in combination, a plurality of distributing blades, means for successively feeding record cards into cooperation with said blades, said blades having their receiving ends progressively decreasing in length, the decrement between ad-

jacent pairs of blade ends corresponding to the interval between the index point positions of the record card, index point controlled means for initiating an opening of the blades, said card operating upon the opening of the blades to arrest the opening of such blade ends already traversed by the advancing card whereby said card and said blade ends of different length effect a selection of a passage between the last traversed blade and the first untraversed blade.

38. A machine for sorting record cards comprising in combination analyzing devices, and distributing devices controlled conjointly by said analyzing devices and by the record card itself, the selection of the distributing devices for determining the card destination being controlled by the direct mechanical coaction therewith of the record card with said distributing devices.

39. A machine for sorting record cards including record analyzing devices and distributing devices and means for selecting the distributing devices to determine the card destination, said means being controlled conjointly by the analyzing devices and by the direct mechanical coaction therewith of the record itself.

40. In a machine of the class described, in combination, means for analyzing a card, a plurality of blades, a movable member under control of the analyzing means, said movable member operating in conjunction with the card acting as a stop member, to open a passage for the card between the blades.

41. In a machine of the class described, in combination, means for successively analyzing differentially located index point positions on a card, a plurality of superimposed blades each blade having its end longer than that of the lower adjacent one, means controlled by said analyzing means on encountering an index point for effecting movement of said blades, said blades being located so that a card being analyzed will project into the path of travel of their ends whereby such a card will act as a stop member for certain of the blades to open a passage for itself between them.

42. In a machine of the character described, in combination, means for analyzing a card, a plurality of superimposed blades and means for separating said blades to open a receiving passage for the card, said means comprising mechanism controlled by the analyzing means for moving the blades and the card being analyzed as a stop member.

43. A card sorting machine comprising card analyzing means, means forming a plurality of distributing passages, means controlled by the analyzing means and including an analyzed card constituting a passage producing element to select a distributing passage for itself according to its analysis by the analyzing means.

44. A card sorting machine comprising card analyzing means, means forming a plurality of distributing passages, means controlled by the analyzing means and including an analyzed card cooperating with said passage forming means to constitute a passage opening element to select a distributing passage for itself according to its analysis by the analyzing means.

45. A card sorting machine comprising card analyzing means, a plurality of blades forming distributing passages between them, means controlled by said analyzing means and including an analyzed card cooperating with said blades to constitute a passage opening element to select a distributing passage for itself according to its analysis by the analyzing means.

46. A card sorting machine comprising card analyzing means, a plurality of blades forming distributing passages between them, means including a movable member controlled by said analyzing means and an analyzing means and an analyzed card cooperating with said blades to constitute a passage opening element to select a passage for itself according to its analysis by the analyzing means.

47. In an analyzing device an analyzing element, a support therefor movable into and out of analyzing position, releasable means for attaching said element to said support and means for preventing removal of said element from its support while in analyzing position.

48. In an analyzing device an analyzing element, a support therefor movable into and out of analyzing position, means for releasably attaching said element to said support comprising manually operated locking means and latching means automatically latched when said element is in analyzing position and unlatched when said element is out of analyzing position.

49. In an electrical analyzing device an analyzing brush, a brush holder therefor mounted on a movable support, an elongated conducting member extending in proximity to the path of travel of said brush holder and a resilient contacting member on said brush holder constantly urged into contact with said conducting member.

50. In an electrical analyzing device an analyzing brush, a brush holder therefor mounted on a longitudinally and laterally movable support, an elongated conducting member extending in proximity to the path of longitudinal movement of said brush holder and a resilient contacting member on said brush holder constantly urged into engagement with said conducting member, the engaging surfaces of said conducting and contacting member being proportioned to maintain contact therebetween on normal lateral movements of said brush holder.

51. An adjustable analyzing device comprising an analyzing element mounted for longitudinal movement and consisting of a brush holder mounted on a movable support, a guide member for restraining said element to its longitudinal path, a conducting member mounted on said guide and extending in proximity to the path of movement of said element and contacting means on said brush holder engaging said conducting member throughout the normal range of travel of said element.

In testimony whereof I hereto affix my signature.

EUGENE A. FORD.

Aug. 12, 1930. C. D. LAKE 1,772,492

RECORD SHEET FOR TABULATING MACHINES

Filed July 20, 1928 2 Sheets-Sheet 1

FIG. 2.

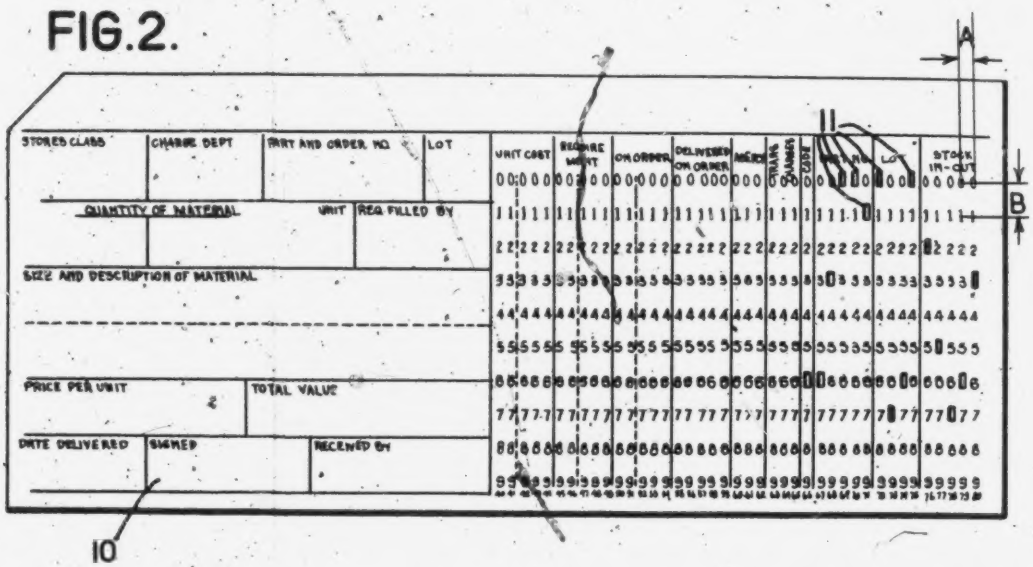
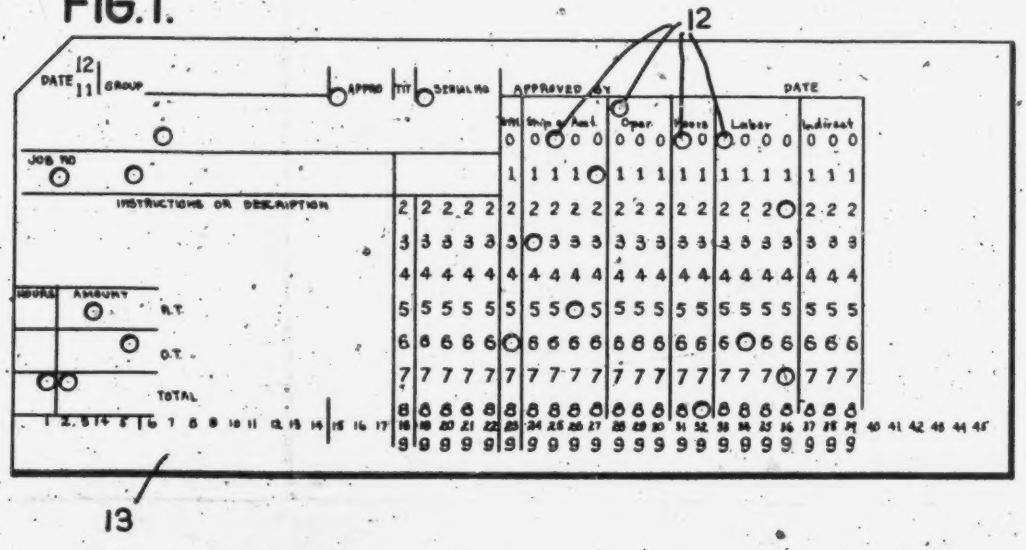


FIG. 1.



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Aug. 12, 1930. C. D. LAKE 1,772,492

RECORD SHEET FOR TABULATING MACHINES

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FIG. 4.

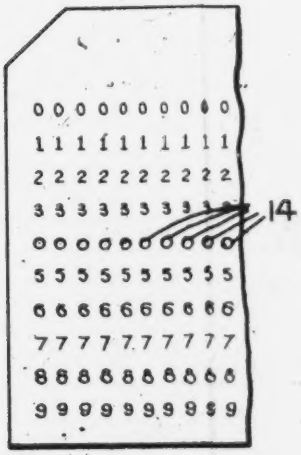


FIG. 5.

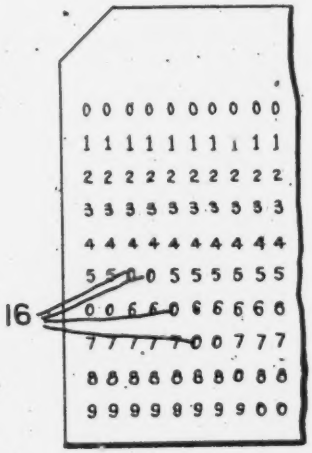


FIG. 3.

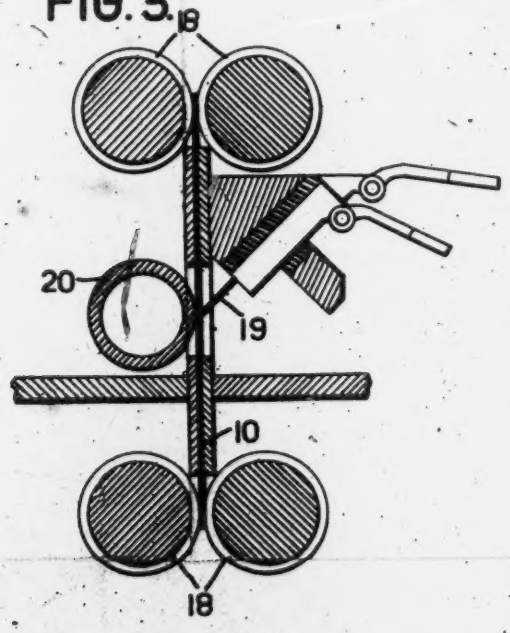
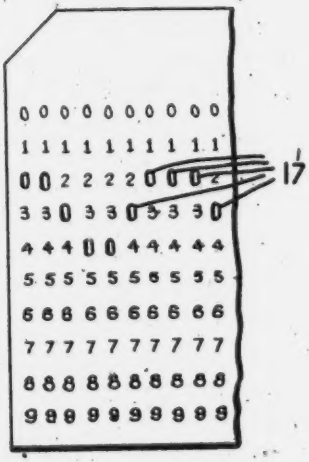


FIG. 6.



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Patented Aug. 12, 1930 1,772,492

UNITED STATES PATENT OFFICE

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RECORD SHEET FOR TABULATING MACHINES

Application filed July 20, 1928. Serial No. 294,110.

This invention is directed to the general end of providing an improved means of placing a greater amount of statistical, or like data, upon a given record card than has been heretofore possible, resulting in increased efficiency and benefits accruing from tabulating, or like machines preferably employed in connection with such record cards. Where card cost and filing space are important considerations, it is possible, by means of the present improvements to place on a record card of appreciably smaller dimensions the same statistical or tabular data placed on record cards of a size heretofore employed.

In machines of the Hollerith type, for example, it has been the practice to provide record cards with index points thereon arranged in columns and with the index points all laterally spaced from each other and arranged in transverse rows. It has also been the practice to space the perforations, which are usually circular, an appreciable and suitable distance apart laterally in order to prevent the brush cooperating with one column of holes from accidentally contacting through the holes of an adjacent column.

While the natural solution of placing more data on a given card is to make the circular perforations smaller in diameter it has been observed that cards having relatively small circular perforations were not satisfactory with respect to machine operation and strength or durability.

In tabulating and sorting machines of the electrical type a certain length of time is required for establishing the circuit through the holes in the card. This length of time and other requirements of the machine have, without resorting to other mechanical expediences, governed the diametrical dimensions of circular card perforations and when the smallest size that could be used was determined it was found that the additional data that could be placed on the new record was, to all extents, not appreciable.

It has also been discovered in practice that as the circular perforations were reduced in diameter and placed closer together a straight line of such perforations would tact and record cards weakened in this manner did not possess the necessary characteristics of strength and durability.

It is then a main object of the present invention to provide an improved means of providing a greater quantity of perforated data upon a record card of a given size without sacrificing card strength or durability as well as to produce a record card that is satisfactory with respect to machine operation and one that may be employed in connection with machines now in commercial use without material changes in the mechanisms therein.

It is a still further object of the present invention to provide an index point having the necessary characteristics and requirements for proper analyzing operations for deriving tabular data from a record card.

In carrying out the present invention the spacing of adjacent card columns is reduced in order to provide more data on a given card, and to provide for the necessary time element for electrical contact the holes are elongated in the direction of card feed. The form and spacings of the perforations are such that considerable resistance to tearing by a series of such perforations is effected.

In the drawings:

Fig. 1 represents a card having the usual form and spacings employed in connection with Hollerith tabulating and sorting machines;

Fig. 2 is a plan view of a perforated record card having index points constructed according to the present invention;

Fig. 3 is a cross sectional view of the brush section of a tabulator, sorting machine or the like, showing the cooperation of an analyzing brush with the preferred form of perforation of an improved record card as the card is fed thereto;

Fig. 4 is a fragmentary portion of a record card employing small circular perforations;

Figs. 5 and 6 are fragmentary portions of record cards illustrating modifications of the present invention.

The improved record card 10 (Fig. 2) is of the usual construction except that the index

gether than the index point designations 12 (Fig. 1) of the usual form of Hollerith record card 13. Since the improved form of perforations are of a reduced width than heretofore it enables a closer lateral spacing of the index point columns and with the attendant possibility of placing more columns of data upon a record card of a given size. The number of columns that may be placed upon a card is determined not only by the required strength of the perforated card but by the closeness to which adjacent brushes may be brought together without the resultant danger of a brush associated with one column engaging an adjacent brush or column perforation resulting in irregular accounting machine operations. The present column width has been adopted with the above in mind and with slight modifications the brushes and holders now employed may be satisfactorily used in connection with the new form of record cards.

Where a series of perforations 11 are required it will be apparent that the card will be weakened along the line of perforations and this is particularly true if the perforations are circular, as indicated by numeral 14 in Fig. 4 which are shown as small as may be practical to use. Such form of perforations materially weaken the card since the circular perforations converge naturally to a tearing line as is readily evidenced by the preferred employment of such perforations for stub cards.

It has been observed that if the perforations are elongated as those indicated by numeral 11 in Fig. 2 and have adjacent substantially straight edges that the resistance to tearing a record card along a horizontal line of perforations is substantially increased. The preferred form of index point perforations 11 are substantially rectangular in which the length is considerably greater than the width. Other forms may be used with similar marked advantages and may be substantially oval-shaped holes 16 shown in Fig. 5 or have adjacent straight edges along the longer side and be substantially circular or elliptical on the other edges such as shown by numeral 17 in Fig. 6.

Considering Fig. 2 it will be apparent that the separation as indicated by A is considerably less than the separation B, the latter being substantially equivalent to a corresponding spacing of the index points of Fig. 1. This requires no change in the timing of the mechanical or electrical parts of the apparatus and the new type of cards may be readily substituted with a similar degree of efficiency in operation. It will be obvious that since a vertical line of elongated perforations never occurs due to the fact that but one perforation in a vertical card column is used the separation at B may also be reduced without materially weakening the card. Thus the same amount of data may be placed on a card of still smaller dimensions.

Observing Fig. 4 it will be apparent that if a card having small circular holes 14 should be fed downwardly by feeding rollers 18 to a brush 19 that the duration of electrical contact is directly proportional to the diameter of the perforation and where holes of small diameters have been employed not sufficient time was given for electrical contact without employing special brush construction and mechanical expediences. With the employment of the elongated form of perforations it will be apparent that a construction is provided which permits a circuit of longer duration even though the perforation is smaller in width than a circular perforation, by reason of the fact that the wires of brush 19 are in contact with the contact member 20 for a greater length of time while the perforation is passing between the brush and the contact member.

In other words, between the time the brush falls into the leading edge of the hole and the time the brush is lifted by the rear edge of the hole a greater length of time will have transpired than when circular holes having a diameter equivalent to the width of the elongated holes are used. At the same time since the card columns may be closer a greater amount of data may be placed on a given card and the card will still be satisfactory with respect to machine operation and structural strength.

By a comparison of Figs. 1 and 2, it will be apparent that a card formed according to the present invention may represent considerable more tabular data than heretofore.

In the present instance 80 columns of data may be placed on a card compared to a 45 column card used heretofore. It will be apparent that when a card having 40 columns is suitable for all purposes record cards constructed according to the present embodiment will be about half the size of regular Hollerith cards giving marked advantages with respect to card cost, ease in handling, reduction in filing space, etc.

While there has been shown and described and pointed out the fundamental novel features of the invention as applied to a single modification it will be understood that various changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claims.

I claim—

1. A tabulating card having oblong control apertures arranged in vertical columns and horizontal lines with the greater dimension in the vertical direction whereby the card is stronger and contains more perfora-

tions than a similar card having similarly arranged and spaced circular perforations of a diameter equal to said vertical dimension.

2. A card as in claim 1 in which the apertures are rectangular.

In testimony whereof I hereto affix my signature.

CLAIR D. LAKE.

O. E. BRAITMAYER.

PAPER TESTING MACHINE.

APPLICATION FILED OCT. 12, 1917.

1,277,039.

Patented Aug. 27, 1918.

5 SHEETS—SHEET 1.

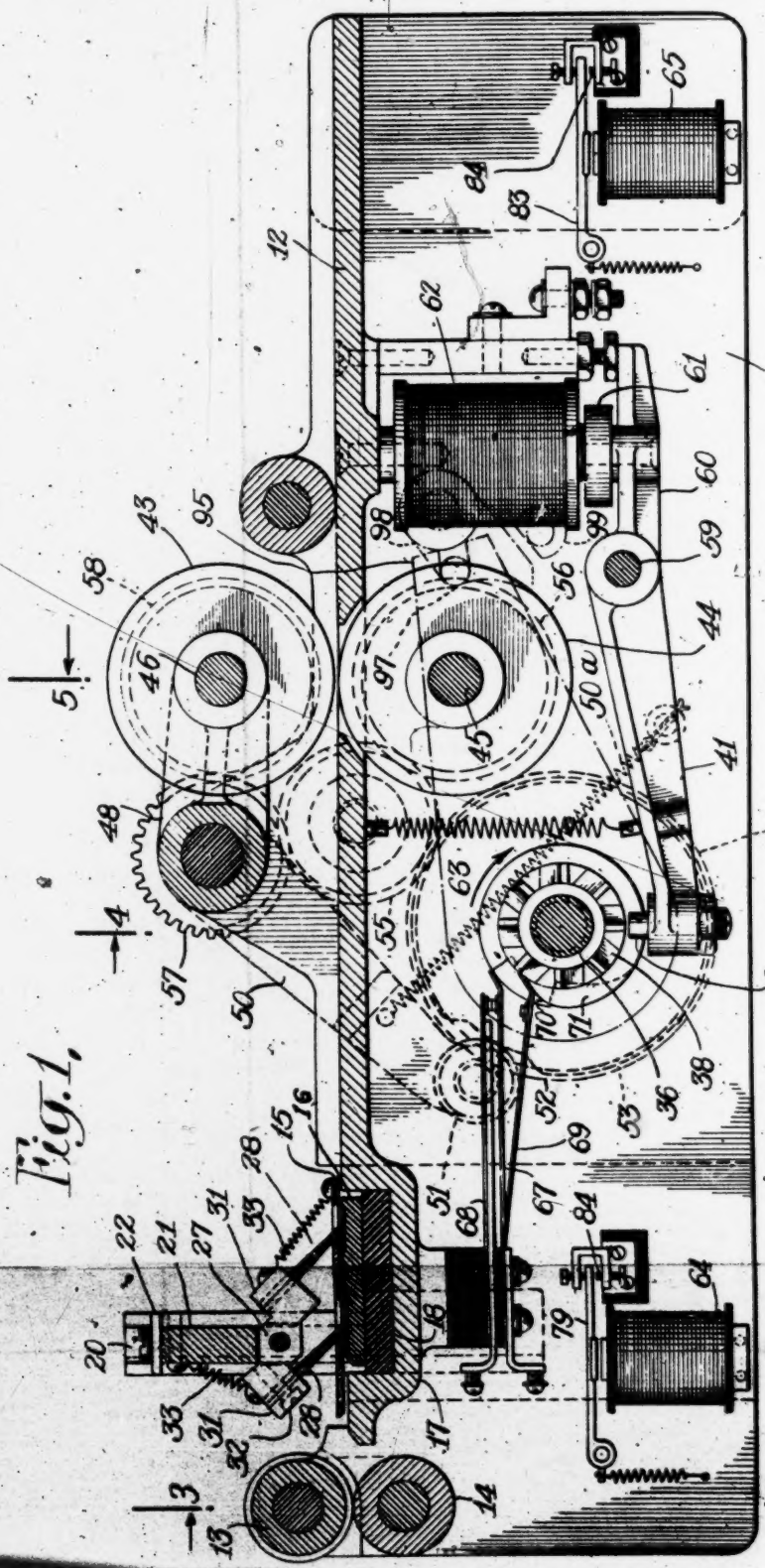

Fig. 1.

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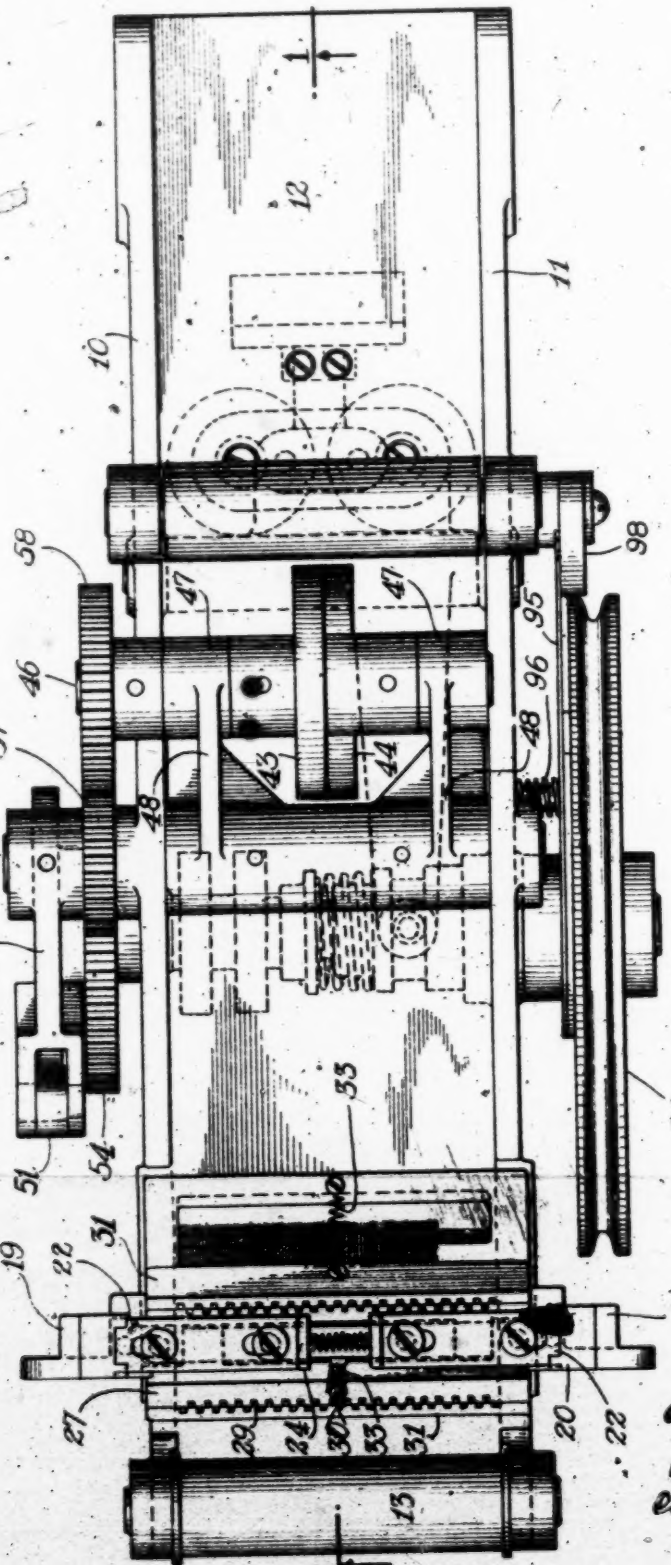

Fig. 2.

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5 SHEETS—SHEET 3.

Fig. 4.

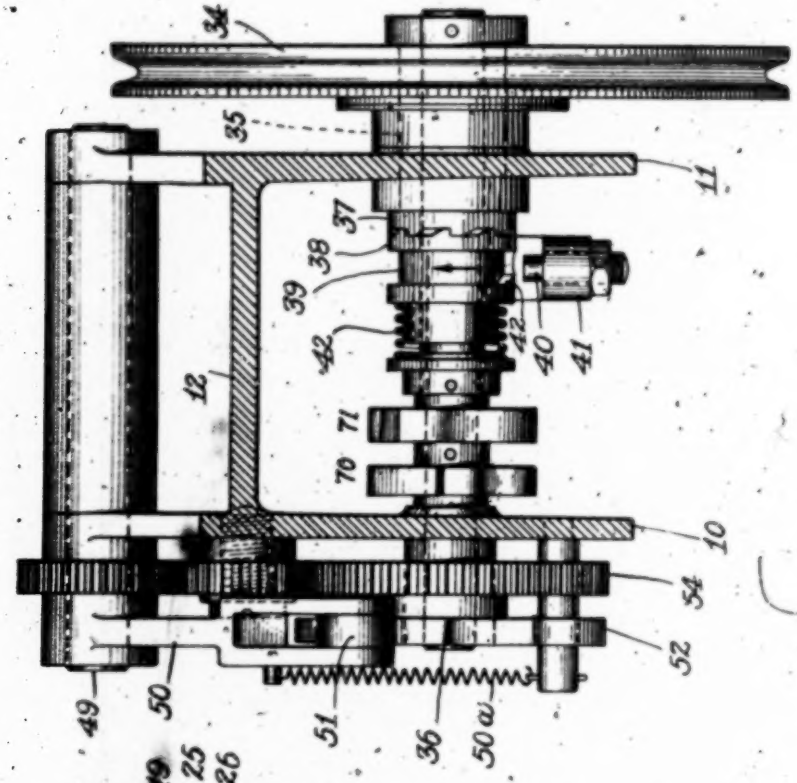
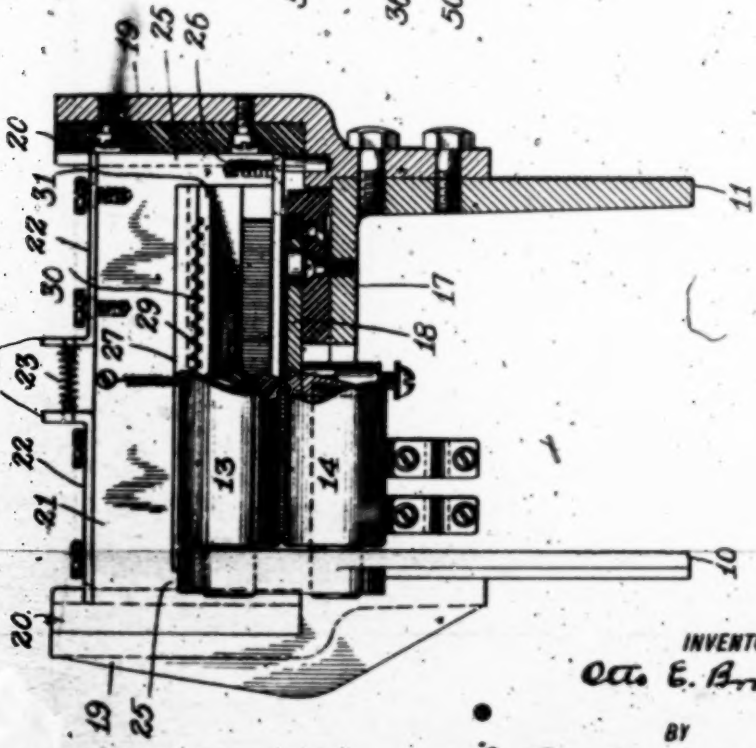


Fig. 3.



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1917

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PAPER TESTING MACHINE.

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5 SHEETS—SHEET 4.

Fig. 7.

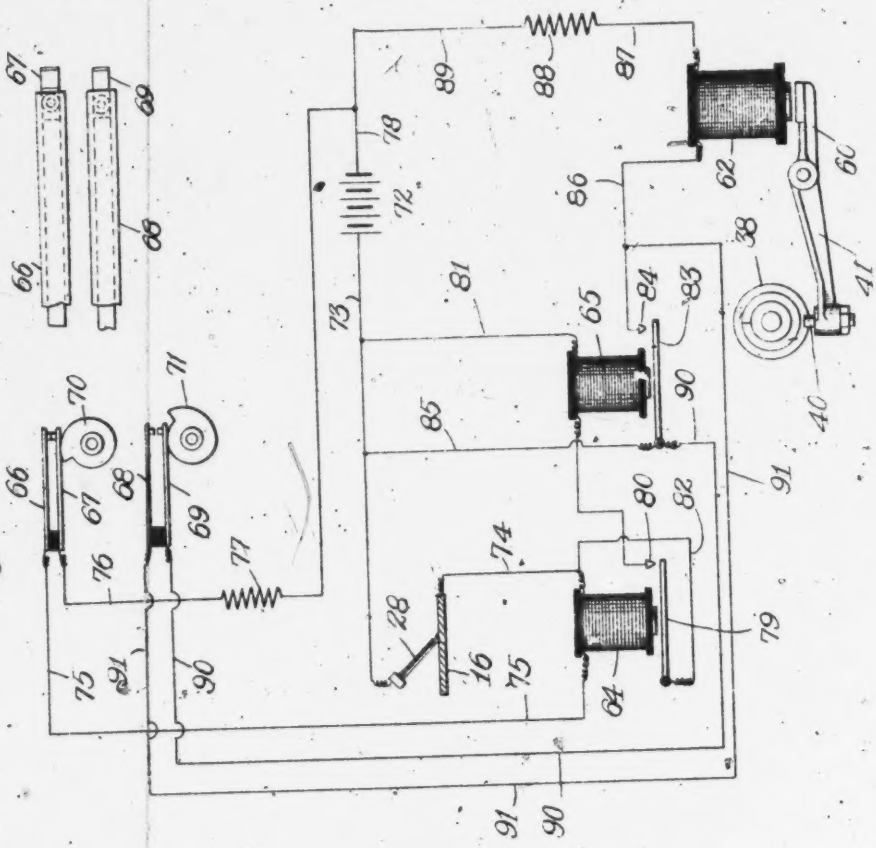

Fig. 6.

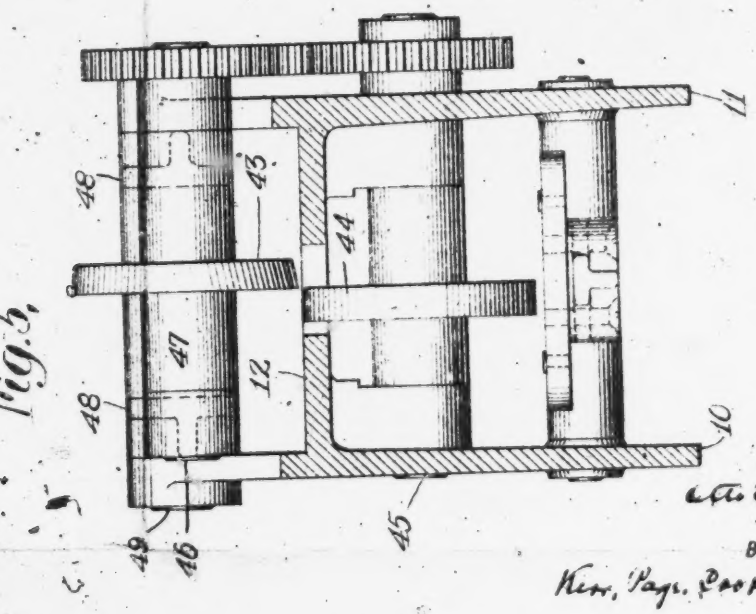

Fig. 5.

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PAPER TESTING MACHINE.

APPLICATION FILED OCT. 12, 1917.

1,277,039.

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5 SHEETS—SHEET 5.

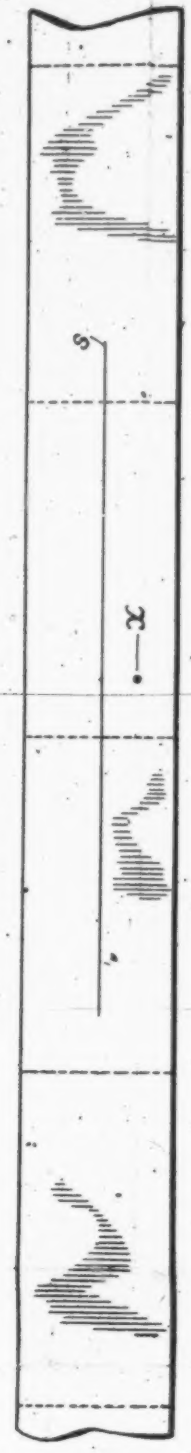

Fig. 8.

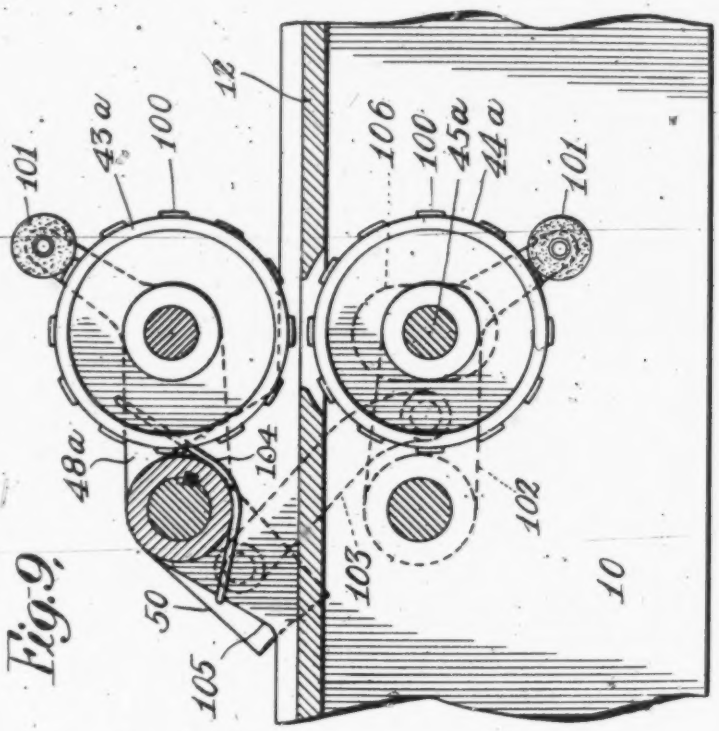

Fig. 9.

INVENTOR

Otto E. Braitmayer

BY

Kerr, Page, Cooper & Hayward

ATTORNEY

UNITED STATES PATENT OFFICE.

OTTO E. BRAITMAYER, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR TO THE TABULATING MACHINE COMPANY, OF WASHINGTON, DISTRICT OF COLUMBIA, A CORPORATION OF NEW JERSEY.

PAPER-TESTING MACHINE.

1,277,039. Specification of Letters Patent. Patented Aug. 27, 1918.

Application filed October 12, 1917. Serial No. 196,210.

To all whom it may concern:

Be it known that I, OTTO E. BRAITMAYER, a citizen of the United States, residing at Washington, District of Columbia, have invented certain new and useful Improvements in Paper-Testing Machines, of which the following is a full, clear, and exact description.

In the Hollerith tabulating system the data to be tabulated are recorded on cards by punching holes therein, after which the punched cards are run through a tabulating machine. In the latter a bank or box of movable contact points or pins are presented to the card. Wherever a contact point finds a hole in the card the point or pin passes through the hole and by engagement with an insulated contact, on which the card rests, closes a circuit, which in turn causes operation of the appropriate register. Where a pin finds no hole it is maintained out of contact with the plate and the corresponding circuit is not closed. The card thus serves as an insulator, and should permit electrical connection to be made only through holes that have been punched for the purpose. Obviously, apertures otherwise occurring in the card, for example imperfections in the stock, may be in such position as to allow a connection to be made elsewhere than through a punched hole. Or there may be embedded in the card a bit of conducting material, usually carbon, which will permit the same result if touched by one of the pins. In either case one or more of the registering mechanisms are actuated unintentionally, thereby rendering the tabulation incorrect.

In Hollerith's prior Patent No. 1,132,345, issued March 16, 1915, he has described and claimed broadly an apparatus for detecting such imperfections as will permit closing of a circuit through the unpunched card. In the specific apparatus described in the patent the cards themselves, of course before they are punched, are passed over the surface of a metal contact plate, above which is a brush extending across the path of the cards and composed of closely set pieces of spring wire with their free ends bearing upon the cards as the latter pass. If any wire comes into electrical connection with the underlying contact-plate by reason of a hole in the card or because of an embedded particle of carbon or metal a circuit is established which stops the card-advancing devices and so permits the defective or imperfect card to be removed.

The present invention is designed for the same general purpose, that is, to detect imperfections in the cards, but it operates preferably on the paper stock before the same is cut up into cards, and mutilates the portion in which an imperfection is found or stamps on the strip in the neighborhood of the imperfection a warning such as the word "Defective," or "Imperfect," or a legend such as "Do not use this card." In the preferred embodiment the paper stock is fed to the machine in the form of a strip of the width of a single card, from which cards of the proper size can be cut by severing the strip transversely. When the brush or brushes strike an imperfection permitting electrical connection with the underlying contact-plate the circuit thus established brings into operation a slitting mechanism which cuts in the strip a longitudinal slit of such length that when the strip is subsequently cut transversely to form the cards the one containing the imperfection will fall into two parts both of which are too small for their intended use. This makes it certain that each full size card cut from the strip contains no imperfection of the kind indicated.

The embodiment thus briefly outlined is illustrated in the accompanying drawings, in which—

Figure 1 shows the machine in vertical longitudinal section, about on line 1—1 of Fig. 2.

Fig. 2 is a plan view of the machine.

Fig. 3 is an end view, partly in cross section about on the line 3—3 of Fig. 1.

Figs. 4 and 5 are cross sections on lines 4—4 and 5—5, respectively, of Fig. 1.

Fig. 6 is a diagram illustrating the wiring, or electrical connections, of the machine.

Fig. 7 is a detail plan view of the start and stop contacts.

Fig. 8 is a plan view of a portion of the card-strip, showing a hole or other imper-

fection and the longitudinal slit cut by the machine.

Fig. 9 is a fragmentary section, on a plane indicated by the line 1—1, Fig. 2, illustrating an embodiment in which the paper-strip, instead of being slit, is stamped with words or characters indicating that the cards bearing the same are unfit for use.

The operative parts of the machine are mounted in or upon a frame comprising two side plates 10, 11, and an elongated bed 12 supported by and between them, the side plates extending a trifle above the bed to form lateral guide-flanges for the paper strip, which, it will be understood, travels lengthwise on the bed between the said flanges. The paper strip, not shown, is received between two horizontal rollers 13, 14, at the rear end of the bed, the roller 13 having guide-flanges at its ends. From the rollers the strip passes forwardly, under a guide-plate 15 and over and upon a universal contact plate 16 sunk in a recess 17 formed in the bed 12, the plate 16 being mounted on a slab or support 18 of insulating material. At the other or forward end of the bed, means (not shown) may be provided, such as friction feed rollers, to draw the paper strip along the bed, but in practice I prefer to use the machine in conjunction with a reeling or winding apparatus, in which case the strip issuing from the bed is seized by the feed mechanism of the reeling apparatus and is drawn over the bed thereby.

At the sides of the path of the strip at the point where the latter passes over the contact 18 are two standards 19, fixed to the side plates 10, 11, and carrying on their inner faces above the bed 12 two vertically slotted members 20 of insulating material, to receive a transverse block 21, which can be removed by sliding it vertically out of the slots. On top of the block are two sliding bolts 22 urged outwardly by a spring 23 into appropriate recesses in the members 20 to hold the block in place. Finger pieces 24 are provided for retracting the bolts to permit removal of the block. The bolts also serve to support the block at the proper height above the bed 12.

The block 21 is provided at its sides with depending arms 25, to the bottoms of which the guide plate 15 is fastened by means of screws 26. Between the arms is a pivoted brush-holder 27, of metal, extending across the plate 15. The brushes are composed of flexible spring wires 28, the alternate wires being mounted in recesses 29, Fig. 3, in the edges of the body of the brush-holder, and the intermediate wires in recesses 30 in the metal strips 31, Fig. 1, which are bound snugly upon the edges of said body by means of screws, as 32, thereby holding the wires tightly in their sockets. Light coil springs 33 are provided to urge the brush-holder in the clockwise direction, causing the brushes, extending through transverse openings in the guide-plate 15, to bear lightly on the paper strip passing beneath.

The machine is driven by a pulley 34, Fig. 4, fixed on the outer end of a sleeve 35 rotatable freely on the transverse shaft 36, which is mounted at its other end in the side plate 10. Fixed on the inner end of the sleeve is a clutch disk 37. The other clutch disk, 38, is feathered on the shaft 36 and has a cam groove 39 coöperating with an actuating pin 40 on the arm 41. The parts being in the positions shown in Fig. 4, and the shaft (and clutch) rotating in the direction of the arrow, it will be evident that if the pin 40 is raised into the groove the incline 42, engaging the pin, will cam the clutch-disk 38 leftwardly out of engagement with the disk 37, thereby disconnecting the shaft 36 from the constantly rotating driving pulley 34. Contrariwise, if the pin is then withdrawn from the groove the spring 42 will shift the disk 38 rightwardly into engagement with disk 37 and the shaft 36 will again be rotated.

The slitting disks 43, 44, Fig. 1, working through an opening in the bed 12, are in shearing engagement with each other, as shown in Fig. 5. Disk 44 is fixed on a transverse shaft 45 journaled in the side plates 10, 11, below the bed, while disk 43 is fixed on a transverse shaft 46, mounted in bearings 47 carried by arms 48 fixed to and extending forwardly from a rockshaft 49. The latter carries an arm 50 having an anti-friction roller 51 bearing on a cam 52, Figs. 1 and 4, rigidly mounted on and therefore rotated by the shaft 36. Hence it will be seen that as the cam rotates, the arm 50 will be rocked, thereby rocking the arms 48 and raising and lowering the cutting disk 43 out of and into engagement with disk 44. Inasmuch as the drop 53 in the cam 52 is of limited extent it will be clear that the disk 43 is held in engagement with the other during the greater part of the revolution of the cam. A spring 50ª urges the arm 50 in the counterclockwise direction and holds the roller 51 in contact with the cam 52.

The slitting disks 43, 44 are rotated from a gear 54 fixed on the shaft 36 alongside of the cam 52. This gear meshes with the gear 55,—which in turn drives gear 56, fixed on shaft 45, and gear 57, which drives gear 58. The latter is fixed on shaft 46. Thus both slitting disks are positively driven from shaft 36.

The arm 41, which, it will be remembered, carries the clutch-actuating pin 40, is fixed on a transverse rock-shaft 59, on which is rigidly mounted an arm 60 carrying the armature 61 of an electromagnet 62. When the magnet is energized the arms 61—41 are rocked counterclockwise, against the

tension of spring 63, thereby carrying the pin 40 out of the cam groove 39, in clutch member 38, and when the magnet is de-energized the spring rocks the arms in the opposite direction, carrying the pin into the groove.

The electrical circuits are controlled by two relays, 64, 65, and two pairs of spring contacts, 66—67 and 68—69. The latter are carried below the recess 17 in the bed 12, and are controlled by two cams 70, 71, rigidly mounted on the shaft 36.

The machine operates as follows: Circuit *a*, which will be traced hereinafter, contains the brushes 28 and universal contact-plate 16, and also contains the contacts 66—67. Normally these contacts are held closed by cam 70, as shown in Fig. 1. The clutch magnet 62 is deënergized and hence shaft 36 and cams 70, 71 are not rotating. Assume now that one or the other of the detector brushes makes contact with plate 18, by reason of a defect in the paper strip passing under the brushes, for example a speck of carbon shown somewhat exaggerated in size at *x*, Fig. 8. Current now flows through circuit *a*, Fig. 6, as follows: battery 72, wire 73, brush 28, universal plate 16, wire 74, relay 64, wire 75, contacts 66—67, wire 76, resistance 77, and wire 78 back to the battery, the resistance being provided to diminish arcing at the brush when the circuit is closed. Relay 64 is thus energized, bringing its armature 79 against contact 80, thereby closing circuit *b*,—from battery 72, wire 73, wire 81, relay 65, contact 80, armature 79, wire 82, relay 64, wire 75, contacts 66—67, wire 76, resistance 77, and wire 78 back to the battery. Thus a shunt is laid across the brushes 28, so that relay 64 will remain energized after the defect or imperfection in the paper has passed the brushes. Relay 65 being energized by the making of circuit *b*, its armature 83 is brought into engagement with contact 84, establishing circuit *c*, as follows: battery 72, wires 73 and 85, armature 83, contact 84, wire 86, clutch magnet 62, wire 87, resistance 88, and wires 89 and 78 to battery 72. This energizes magnet 62, rocks lever 60—41, and withdraws the pin 40 from clutch disk 38, thereby permitting the spring 42 to shift the disk into engagement with clutch disk 37. Shaft 36 now begins to rotate, and with it the slitter-actuating cam 52 and the contact cams 70, 71. Contact cam 70 (rotating in the direction of the arrow, Fig. 1) acts first, breaking circuit *a* at contacts 66—67, though this circuit may have already been broken by movement of the paper strip carrying out from under the brushes the imperfection which permitted one or the other of the brushes to come into electrical connection with the plate 16. But the opening of circuit *a* at contacts 66—67, also opens circuit *b*, thereby deënergizing relay 65,—without, however, deënergizing the clutch magnet, for the reason that in the meantime contact cam 71 has raised contact 69 into engagement with contact 68, so that circuit *d* is established as follows: battery 72, wires 73, 85 and 90, contacts 69—68, wires 91, 86, clutch magnet 62, wire 87, resistance 88, wires 89 and 78, to battery 72; thus maintaining the clutch magnet energized and the clutch 37—38 in operation. Circuit *d* may therefore be conveniently termed the "maintaining circuit." Shaft 36 therefore continues to rotate, carrying the drop in cam 52 beyond the end of arm 50 and thereby swinging cutter disk 43 down into cooperation with disk 44. The disks named now begin to cut a slit *s*, Fig. 8, in the advancing paper-strip. Also, contact cam 70 re-closes contacts 66—67, without, however, reëstablishing circuit *a* since the latter has been opened at brush 28, and without reëstablishing circuit *b* since the reëstablishment of that circuit requires closing at brush 28 as well as at contacts 66—67. Eventually the continued rotation of shaft 36 brings the drop in cam 52 back under the arm 50, thus raising the upper disk 43 and hence stopping the mutilation of the paper-strip; and, also, the drop in contact cam 71 comes under contact 69, thereby breaking circuit *d*. This deënergizes clutch magnet 62, whereupon arm 41 carries the pin 40 up into the cam groove 39 as the rise therein approaches, and shortly afterward the clutch opens. Shaft 36 now ceases to rotate, leaving the parts in the positions shown in Fig. 1, namely, with the drop 53 in cam 52 under the end of arm 50, the drop in contact cam 70 a short distance from the contact 67, and the drop in contact cam 71 under contact 69. The paper-mutilating cycle is thus completed.

If before the completion of the above-described cycle the brushes should find another imperfection in the paper-strip the circuits *a* and *b* will be reëstablished as already described, thereby causing another slitting operation to be performed immediately upon the conclusion of the one then in progress.

In the specific embodiment described, the linear length of the slit cut in the paper-strip depends, in general, upon the speed of the strip and the angular speed of the cam shaft 36. Thus if the rate of travel of the strip be increased the paper will move farther, and hence have a longer slit cut in it, before the clutch magnet is deënergized and the cutting disks are separated; and vice versa. Also, if the angular speed of the cams be increased the cutting disks will be separated earlier, and the slit will therefore be shorter. But it is best not to advance the strip faster than the cutting disks can shear it, inasmuch as attempting to pull

the strip faster through the disks is apt to result in tearing the strip. Attempting to push the paper through faster than the disks can shear it will simply buckle the paper up in front of the disks.

Two brushes are used to insure complete covering of the strip, so that if the first brush (the leftward brush in Fig. 1) misses an imperfection the second will find it. In many, probably in most, cases both brushes "find" the same imperfection. This will lengthen the normal cycle from one revolution of the cam shaft to two revolutions, unless, in general, the timing of the electrical functions of the machine be such that the clutch is not engaged (and the cycle therefore not begun) until the imperfection has passed the second brush.

The cam shaft should rotate only in the direction of the arrow (Fig. 1) since reverse rotation might damage one or both of the contacts 67, 69. To prevent such reverse rotation I provide a friction plate 95, (shown in broken lines in Fig. 1) loose on the hub of the pulley 34, Figs. 2 and 4, but held in frictional contact with the side of the hub by a spring 96. At its free end the plate is recessed to receive the stud 97 on the side of a pawl 98 the point of which is adapted to engage serrations on the inner edge of the pulley. When the pulley is rotating in the direction of the arrow, Fig. 1, the friction plate 95 is urged in the same direction thereby holding the pawl down upon the stop 99. The pawl then offers no interference with the free rotation of the pulley; but if the pulley starts in the opposite direction the friction plate instantly swings the pawl up into engagement with the serrated edge and prevents further movement.

As previously indicated, it is within the spirit of my invention to mark the strip in a distinguishing manner so as to warn the subsequent user of the cards which are cut from the strip. For this purpose the machine may be exactly like the one already described, except that one or both of the cutting disks are changed to printing disks, for example as in Fig. 9. In this figure the disks 43ª, 44ª, are arranged in the same vertical plane and are provided with type 100 on their peripheries, inked by porous rollers 101 charged with ink. The lower disk is mounted on a swinging arm 102 connected by a link 108 to the arm 50 so that as the latter is rocked by the cam 52 the disks will be swung into and out of contact with the opposite sides of the paper-strip. The arm 48ª, which carries the upper disk may have spring connection 104 with the standard 105 so that it will yield upwardly as the disks bear upon the paper and press upon the latter with sufficient force to produce clean, strong imprints. The shaft 45ª, on which the lower disk is mounted, rises and falls in a slot 106 in the side frame 10. The gearing for driving the disks is not shown in Fig. 10. In fact the gearing is preferably omitted and the disks rotated by frictional engagement with the advancing paper-strip.

It is to be understood that the invention is not limited to the specific construction herein described but can be embodied in other forms without departure from its spirit. In the appended claims I use the expression "damaging the strip", or the like, as a generic term to mean any effect upon the paper which will render it unfit for cutting into cards or will indicate that particular cards cut from it are unfit for use.

I claim:

1. In a machine for testing a paper-strip moving therethrough, the combination with mechanism for damaging the strip, of means for controlling the same, including a normally open controlling circuit having devices acting automatically to close the circuit through an imperfection in the strip.

2. In a machine for testing a paper-strip moving therethrough, the combination with mechanism for damaging the strip longitudinally, of means for causing the said mechanism to damage the paper-strip from a point in front of to a point behind an imperfection in the strip, said means including a controlling circuit having relatively movable contacts normally separated by the paper-strip.

3. In a machine for testing a paper-strip moving therethrough, the combination of a contact on one side of the path of the paper-strip, a brush on the other side of said path and normally insulated from the contact by the paper-strip but adapted to make electrical connection with the contact through an imperfection in the paper, a normally open circuit controlled by the brush and contact, and mechanism controlled by the circuit to damage the paper-strip when the circuit is closed.

4. In a machine for testing a paper-strip moving therethrough, the combination with normally separated slitting disks on opposite sides of the path of the paper-strip, of means for shifting at least one of the disks into coöperation with the other to slit the strip, and a controlling circuit for said means, having contacts on opposite sides of the path of the paper strip and normally separated by the latter but adapted to close the circuit through an imperfection in the paper.

5. In a machine for testing a paper-strip passing therethrough, the combination with normally separated and normally non-rotating slitting disks on opposite sides of the path of the paper-strip, of means for

rotating the disks, means for shifting at least one disk into coöperation with the other to slit the paper-strip, and a normally open controlling circuit for both said means, having devices operating automatically to close the circuit through an imperfection in the paper-strip.

6. In a machine for testing a paper-strip moving therethrough, the combination with normally separated slitting disks on opposite sides of the path of the strip, of a normally inactive cam for shifting at least one of the disks into engagement with the other to slit the strip, means for actuating the cam; and electromagnetic mechanism for controlling said means, including a normally open controlling circuit provided with devices normally separated by the paper-strip and acting automatically to close the circuit through an imperfection in the paper.

7. In a machine for testing a paper-strip moving therethrough, the combination with normally inactive mechanism for mutilating the paper-strip; of driving means for said mechanism; means for setting the driving means in operation, including a normally open circuit having devices acting automatically to close the circuit through an imperfection in the paper-strip; and means for disabling the driving means, including a maintaining circuit having means actuated by the driving means to open the maintaining circuit.

In testimony whereof I hereunto affix my signature.

OTTO E. BRAITMAYER.

Oct. 12, 1926. 1,602,810

F. M. CARROLL

POWDERING MACHINE

Filed Dec. 11, 1924 2 Sheets-Sheet 1

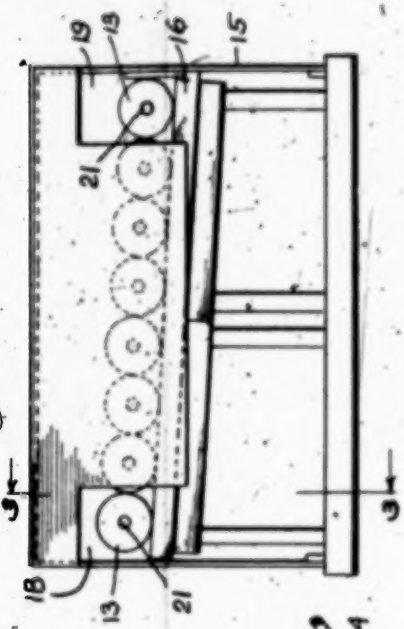

Fig. 2.

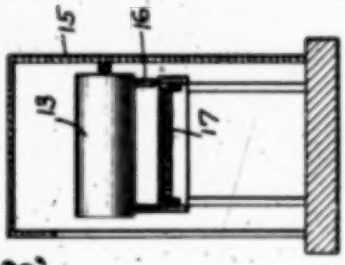

Fig. 3.

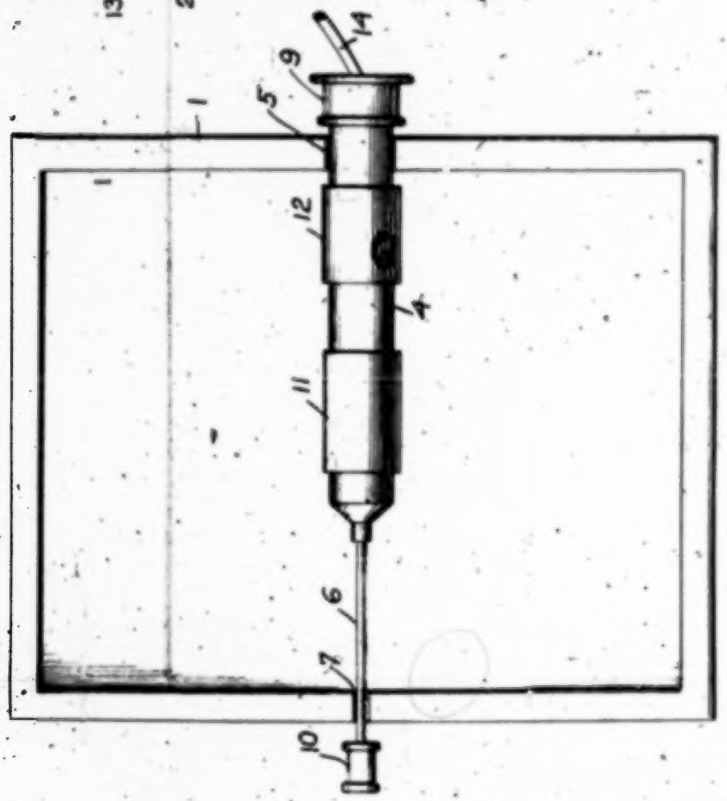

Fig. 1.

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Fred M. Carroll

By his Attorneys
Cooper, Kerr & Dunham

Oct. 12, 1926. 1,602,810

F. M. CARROLL

POWDERING MACHINE

Filed Dec. 11, 1924 2 Sheets-Sheet 2

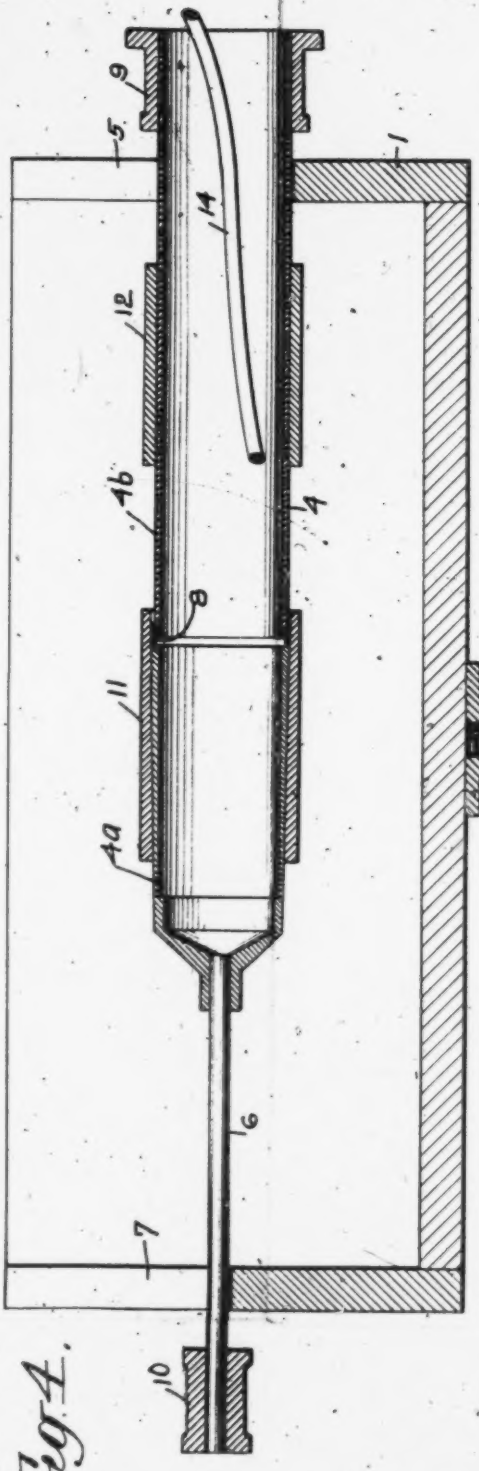

Fig. 4.

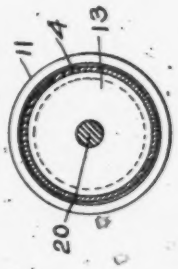

Fig. 6.

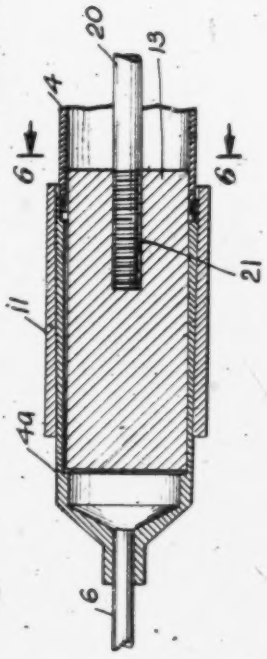

Fig. 5.

Inventor
Fred M. Carroll

By his Attorney
Cooper, Kerr & Dunham

Patented Oct. 12, 1926. 1,602,810

UNITED STATES PATENT OFFICE.

FRED M. CARROLL, OF ENDICOTT, NEW YORK, ASSIGNOR TO THE TABULATING MACHINE COMPANY, OF ENDICOTT, NEW YORK, A CORPORATION OF NEW JERSEY.

POWDERING MACHINE.

Application filed December 11, 1924. Serial No. 755,168.

This invention relates to dusting or powdering devices, for use in applying what is commercially known as dragon's blood to etchings in the process of being made.

In making etchings it is common practice after the acid has eaten into the metal a short distance, to suspend the working or application of the acid, and to apply the dragon's blood powder to the sides of the upstanding letters or other characters. After this has been completed the acid is again applied, and after it has eaten a little deeper, the powdering operation is repeated. This may be done several times during the etching. The reason for the application of the powder is to protect the sides of the letters from the action of the acid so that the acid will not eat into the sides of the letters and weaken their structure.

Ordinarily the application of the powder is accomplished by laying the plate in a horizontal position and stroking its surface with a brush which has been dipped into the powder. The stroking is done in one direction at a time, care being taken to remove all powder from the plate except that which is banked against the sides of the characters. The plate is then heated to bake the powder in position, so that it will hold firmly. After the plate has been cooled, the powder is applied by stroking in another direction to apply the powder to another side of the raised characters. The cycle is repeated until the powder has been applied in four directions so as to completely surround the characters. The acid is again applied, and after it has eaten a little deeper the whole process of powdering is repeated. The alternate etching and powdering is carried on a number of times depending upon the depth of etching desired.

The work of powdering, with its attendant baking and cooling is relatively easy when performed on flat plates as is the usual practice. But when working on the peripheral surface of cylinders, the work of powdering, heating and cooling is much more difficult.

The object of the present invention is to devise a method and means for performing this work on cylinders, with greater ease, greater speed and a higher degree of efficiency.

Referring to the drawings wherein I have shown what I now consider to be the preferred form of my invention:—

Fig. 1 is a plan view of my powdering device.

Fig. 2 is a side elevation of a device used for heating irons for use in connection with the powdering device.

Fig. 3 is a section of the heating device taken on line 3—3 of Fig. 2.

Fig. 4 is a longitudinal vertical sectional view of the powdering device and associated parts shown in the top plan view of Fig. 1.

Fig. 5 is a view of a portion of the device shown in Fig. 4, showing the heating iron in place.

Fig. 6 is a section taken on line 6—6 of Fig. 5.

In the drawings, 1 represents a box, pivotally mounted as at 2 upon a supporting base 3, only a fragment of which is shown. A tube 4 is shown as resting at one end in a notch 5 in one end of the box, and a stem 6 fixed to the other end of the tube rests in a notch 7 in the other side of the box. For convenience in construction, the tube may be made in two sections 4^a and 4^b screwed together at 8 as shown. The outer end of the tube is provided with a heat resisting sleeve 9, and the outer end of the stem 6 has a similar sleeve 10. These will enable the operator to handle the device while it is hot. They also serve as limit stops, preventing endwise movement of the tube so far as to permit the end of the tube to fall into the box. One end of the tube is closed and the other open. The portion 4^a of the tube tapers from its left hand end to a larger outer diameter toward the right to receive the cylinder 11 which is being engraved and which is tapered on its inner side to fit upon the press. The cylinder thus fits snugly over the supporting tube. A sleeve 12 loose on the tube 4 may be provided for the purpose of loosening the cylinder from the tube when it is to be removed; the cylinder being tapped on the end with said sleeve. The stem 6 is lifted out of its groove 7 when a cylinder is being placed upon, or removed from the tube.

After the cylinder has been partly etched, it is placed upon the powdering device. The operator then strokes the cylinder in one direction with the powdering brush, while turning the knob 10 to rotate the supporting

tube and the cylinder. The powder is thus applied evenly about the entire circumference of the cylinder. A heated iron is then thrust into the tube as in Fig. 5, and the tube is rotated so that the iron will be brought into contact with the tube about its whole inner circumference. Heat is applied in this manner to the cylinder 11 to bake the powder in position against the sides of the partially etched characters.

After the baking has been completed, the iron 13 is removed, and a hose 14 is inserted in the end of the tube, and the tube is flooded with water to cool the cylinder. The cylinder is then stroked in another direction and the process repeated until the powdering has been effected in the four directions.

By swinging the box 1 about its supporting pivot 2, the tube 4 may be maneuvered into convenient position for the insertion of the heating irons, and it may be turned to another position when cooling, so that the water may flow out of the end of the tube into a waster trough.

In order to maintain a constant supply of heating irons for use in operating one or more of the powdering devices, I have provided a heater 15 (Figs. 2 and 3), having an inclined trackway 16 upon which the irons 13 may be placed. An electric heating coil 17 or other suitable means may be provided for heating the irons. The coil 17 is disposed below the trackway 16. The irons may be placed in the heater at the upper end of the inclined track, through an opening 18, and removed therefrom through an opening 19 at the lower end of the track. Thus, the iron which has been in the heater longest is always the one that is removed and has therefore had sufficient time to become heated.

For handling the irons, a rod 20 (Fig. 5) may be provided. The rod may be screwed into the threaded hole 21 in the iron, and may be removed when the iron is replaced in the heater.

Having described my invention, what I claim and desire to secure by Letters Patent is:—

1. In a powdering device, a tube adapted to support a cylinder being prepared for etching, and means comprising a heated metallic member for uniformly imparting heat to the internal surface of said tube and thereby to the cylinder supported thereby.

2. In a powdering device, a rotatable tube adapted to support a cylinder being prepared for etching, and a mounting for said tube, the aforesaid tube having an open end which affords access to the interior thereof for the introduction and interchange of various devices when the cylinder is in working position upon its tube-like support.

3. In a powdering device, a rotatable tube adapted to support a cylinder being prepared for etching, a rotatable mounting for said tube, said rotatable mounting and support being provided with an accessible fixed opening in one end thereof constructed to afford access into the interior of said tube and the introduction thereinto of a heating inner tube having an outer diameter substantially co-extensive with the inner diameter of said tube.

4. In a powdering device, a tube adapted to support a cylinder being prepared for etching, means for applying heat to the interior of said tube for heating the cylinder, and means for cooling said tube for cooling the cylinder.

5. In a powdering device, a rotatable tube adapted to support a cylinder being prepared for etching, means for heating the cylinder, and means within the tube for cooling the cylinder.

6. In a powdering device, a rotatable tube adapted to support a cylinder being prepared for etching, means for heating the interior of the tube for heating the cylinder, and means for applying a cooling fluid to the interior of the tube for cooling the cylinder.

7. In a powdering device, a rotatable supporting member adapted to support a cylinder, being prepared for etching, means for heating the cylinder, and means within the said member for cooling said cylinder by internally lowering the temperature thereof.

8. In a powdering device, a rotatable supporting member adapted to support a cylinder being prepared for etching, means for heating said member to heat the cylinder, and means for cooling said member for cooling the cylinder.

In testimony whereof I hereto affix my signature.

FRED M. CARROLL.

March 6, 1928. 1,661,560

F. M. CARROLL

MACHINE FOR PHOTOGRAPHICALLY PRINTING ON CYLINDERS

Filed Dec. 12. 1924 5 Sheets-Sheet 1

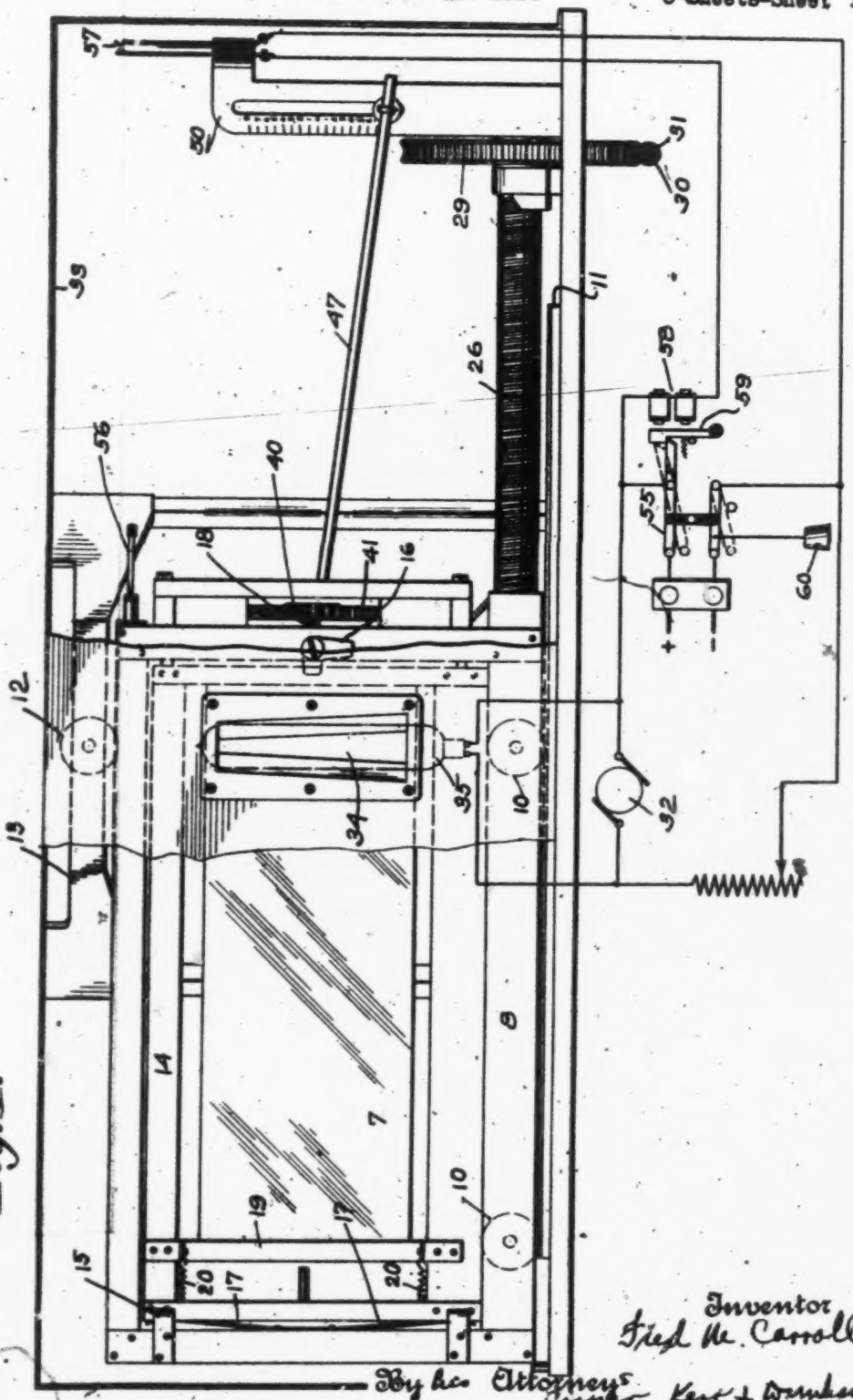

Fig. 1.

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MACHINE FOR PHOTOGRAPHICALLY PRINTING ON CYLINDERS

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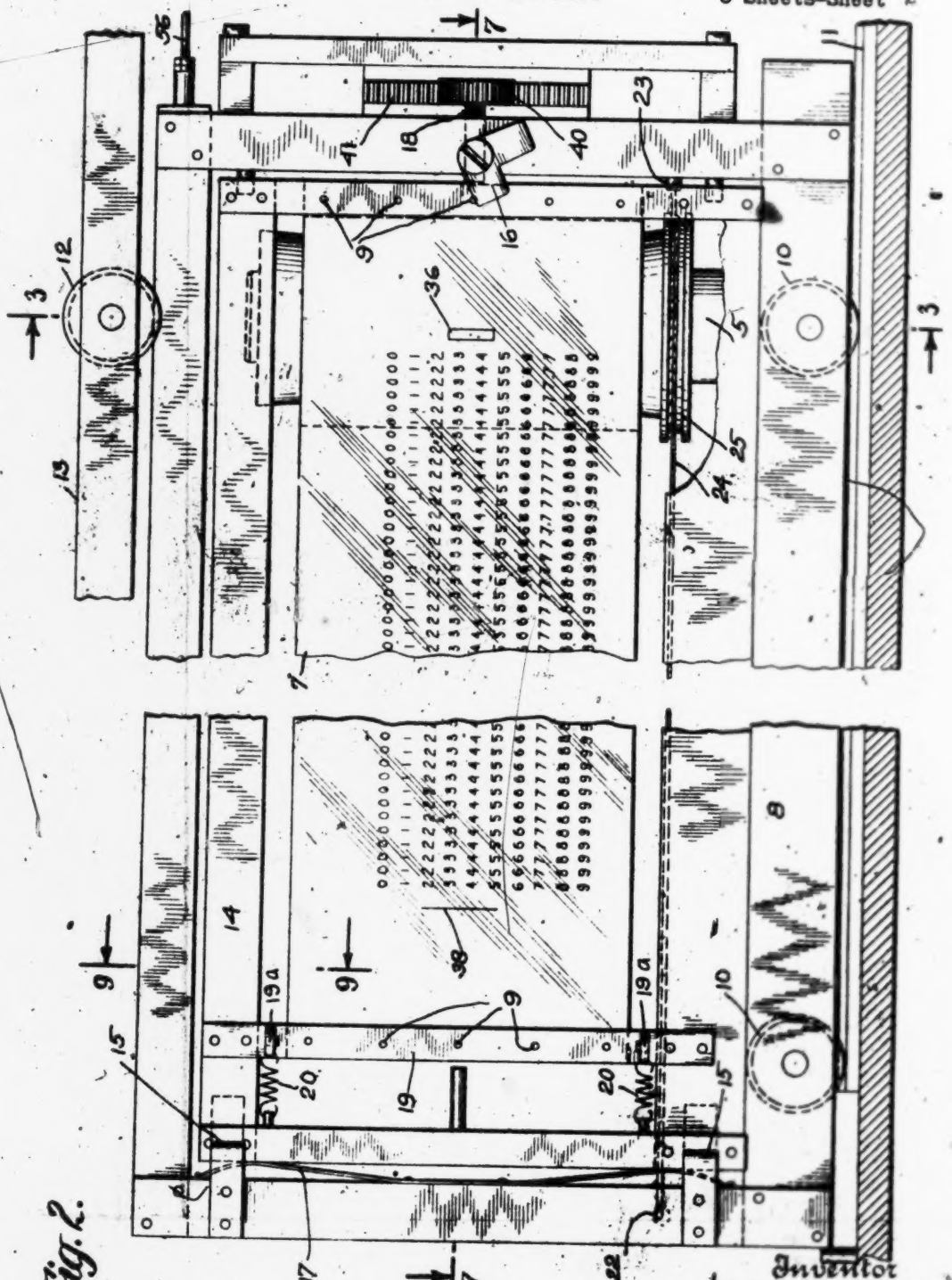

Fig. 2.

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MACHINE FOR PHOTOGRAPHICALLY PRINTING ON CYLINDERS

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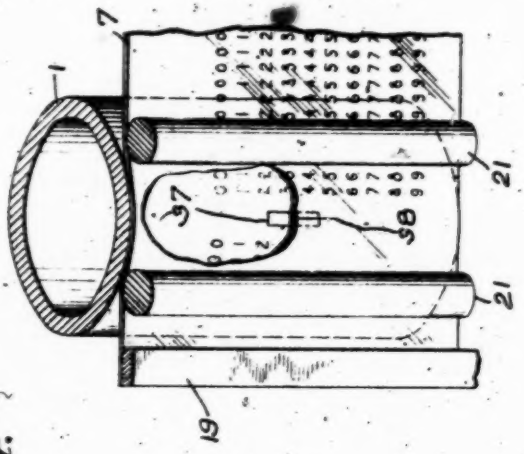

Fig. 4.

D-354

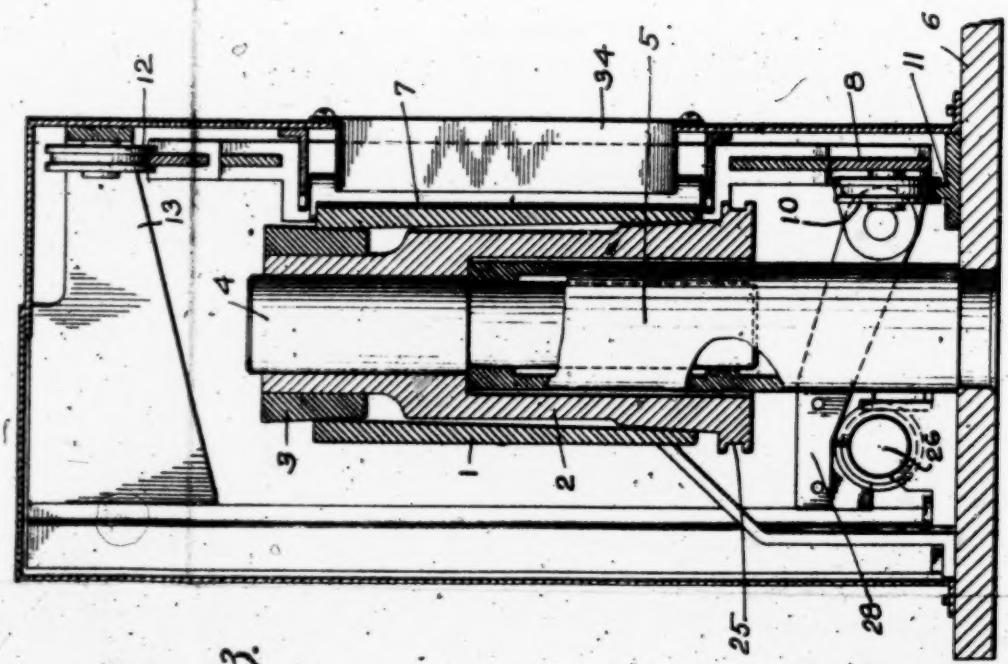

Fig. 3.

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Filed Dec. 12, 1924 5 Sheets-Sheet 4

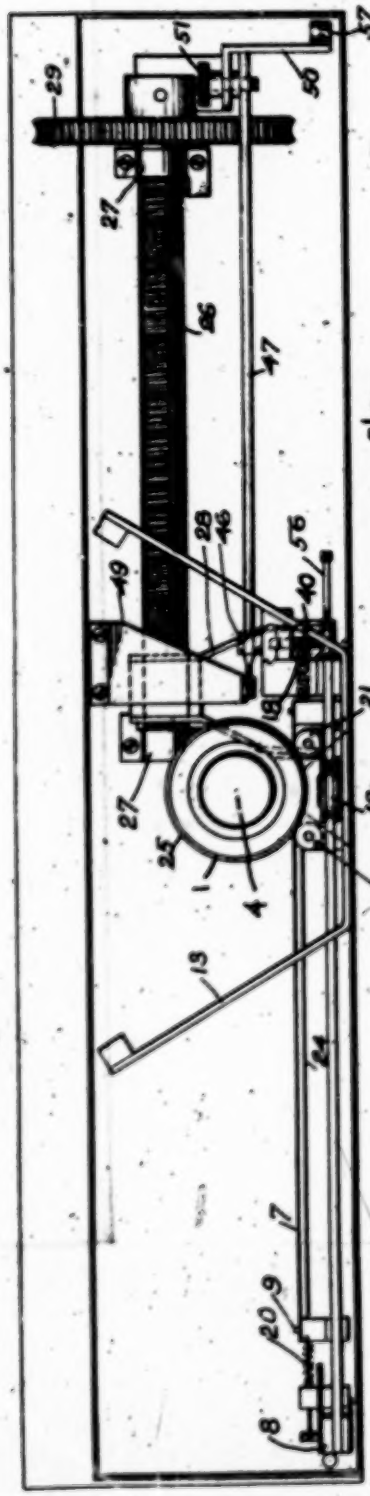

Fig. 5.

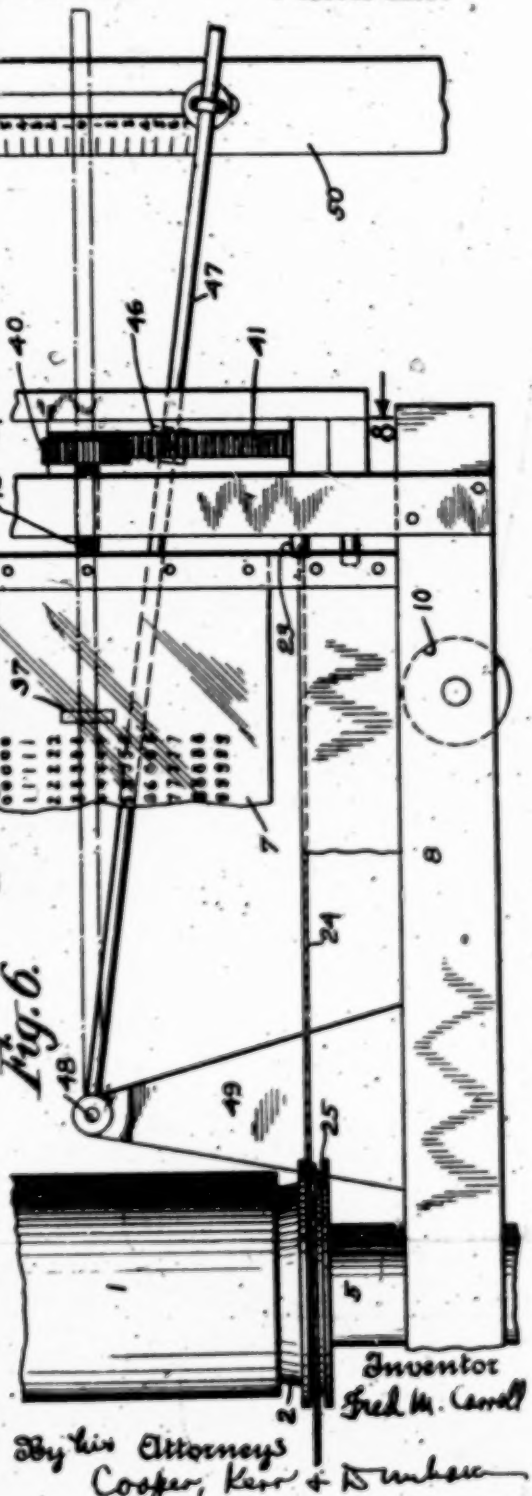

Fig. 6.

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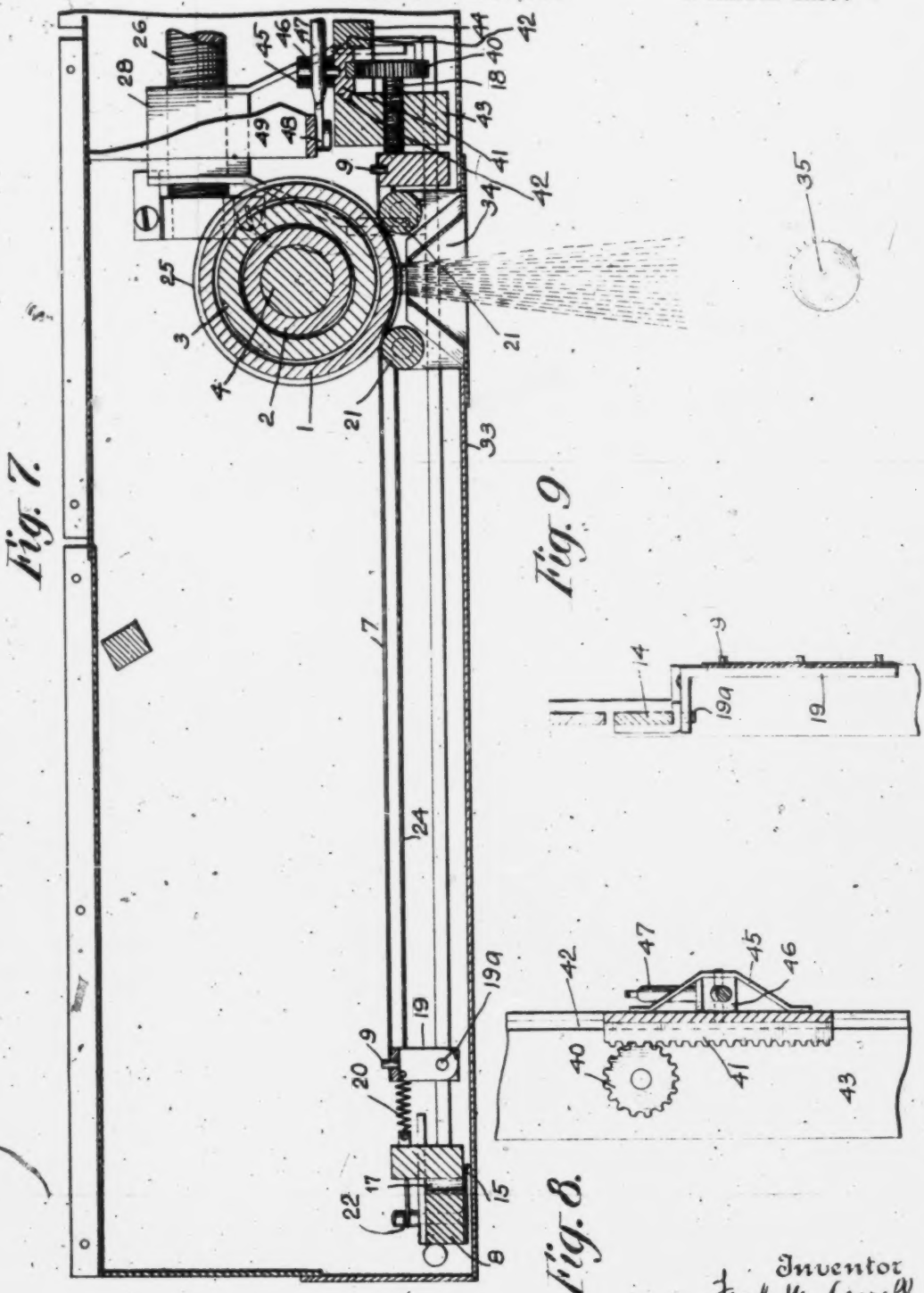

Fig. 7.

Fig. 9

Fig. 8.

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UNITED STATES PATENT OFFICE.

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MACHINE FOR PHOTOGRAPHICALLY PRINTING ON CYLINDERS.

Application filed December 12, 1924. Serial No. 755,372.

This invention relates to negative transfer or photograph printing machines. More specifically, it relates to machines for transferring images or characters from a photographic film to a cylinder which is to be etched for printing purposes.

Ordinarily it is possible to produce the engraving on a flat piece of metal and to curve the latter into a self supporting cylinder, or to wrap it about a cylindrically shaped supporting member. Where a high degree of accuracy is desired, however, it has been found to be more practicable to do the etching directly upon a well finished cylinder.

The object of the present invention is to devise a method and means for transferring the images or characters with a high degree of exactness to an accurately proportioned cylinder.

In illustrating the invention, I have shown a cylinder as being prepared for an etching with which to print record cards for use in tabulating machines. In this instance the circumference of the cylinder is equal to the length of the card which is to be printed, and the characters must be accurately placed on the card.

Referring to the drawings wherein I have shown what I now consider to be the preferred form of my invention:—

Fig. 1 is a front elevation of the machine with the covering partly broken away to show the interior. The view also includes an electric wiring diagram.

Fig. 2 is an enlarged view of the left hand end of the machine seen in Fig. 1, showing the interior.

Fig. 3 is a section taken on line 3—3 of Fig. 2, showing the mounting of the cylinder to be etched.

Fig. 4 is a fragmentary detail showing the film from which the transfer is being made, and the cylinder to which it is being made.

Fig. 5 is a plan view of the machine.

Fig. 6 is a fragmentary detail of the right-hand end of the machine as seen in Fig. 1, showing adjusting mechanism for regulating the relative speeds of movement of the cylinder and the film while the transfer is being effected.

Fig. 7 is a section taken on line 7—7 of Fig. 2.

Fig. 8 is a sectional detail of the speed regulating mechanism, taken on line 8—8 of Fig. 6.

Fig. 9 is a sectional detail of the film carriage, taken on line 9—9 of Fig. 2.

In the drawings, the cylinder 1, which has been coated with a light-sensitive substance, is mounted on a rotatable member 2, and is centrally and securely held thereon by a tapered sleeve 3. The member 2 is fixed on a spindle 4 reaching into a hollow post 5 fixed to the base 6 of the machine. The member 2 is thus adapted to rotate about a vertical axis.

The transparent film 7, from which the transfer is to be made, is produced by photographing a form made up in accordance with the form of card desired. The film is made as near as possible to the exact size of the card to be printed. The film is mounted in a carriage 8; holes along the ends of the film adapting it to be hooked over pins 9 on the carriage. The carriage is provided with flanged wheels 10 mounted on a track 11 for movement across the machine. The upper frame work of the carriage is guided between the flanges of a trolley wheel 12 mounted on a fixed bracket 13. Removably mounted in the carriage 8 is the film frame 14, held in position by projections 15 and latch 16 on the carriage frame. The left-hand end of the film frame presses against a leaf spring 17, and the right-hand end butts against an adjusting screw 18. The pins 9 at the right-hand end of the film frame are fixed directly to said frame, while those in the left-hand end are fixed to a bar 19, pivotally mounted on the film frame as at 19^a (Fig. 9), pulled toward the left by springs 20. This causes the film to be pulled taut irrespective of slight variations in the length of the film. It also permits the film support to yield when the film is pressed into contact with the cylinder to conform to the curvature thereof for a short distance as seen in Figs. 4 and 7. The film is held against the cylinder in this manner by upright rollers 21 carried by a removable cover 33 dowelled to the machine base so as to be removable therefrom.

Attached to the carriage 8 at 22 and 23 is a cord 24. This cord is wrapped around a grooved portion 25 of the cylinder-supporting member 2, and is tightly drawn. Thus, as the film carriage is moved across the machine, the cylinder is caused to rotate, to maintain a rolling contact with the film.

The movement of the film carriage is ef-

fected by means of a screw 26 mounted in bearings 27 fixed with respect to the machine. The screw cooperates with a threaded bracket 28 fixed to the carriage. The screw 26 has fixed to one end thereof, a work wheel 29, meshing with a worm 30 on the shaft 31 of an electric motor 32.

The parts are enclosed within a casing 33, having a window 34 adapted to permit the rays of light from a source 35 to penetrate the film where the latter is in contact with the cylinder. As shown in Fig. 1, the window may be wider at the bottom than at the top. The reason for this is that after coating the cylinder with the light-sensitive emulsion, it is stood on one end while drying, and this permits the emulsion to flow downwardly so that when dried, the coating is slightly thicker and denser at the lower end than at the top. The wider opening will expose the lower end of the cylinder to the light for a greater length of time, and the effect of the exposure is uniform throughout the width of the cylinder.

In Fig. 1, the light 35 is shown as of the bulb type; narrow and long enough to cover the full width of the film, and may have a concentrated filament and be filled with nitrogen. Such a light may be placed in front of the window in the relationship indicated in dotted lines in Fig. 1. Where a point source of light is used, however, the light is preferably placed low with respect to the window 34, as indicated at 35a, so that the light will be more intense where the emulsion is thicker on the cylinder.

In setting up the machine the film carriage is placed at the extreme left-hand of the machine, with the right-hand portion of the film in contact with the cylinder, as in Figs. 2 and 7. In this position, a rectangular hole 36 through the film, rests over the cylinder. Through this hole, the operator traces a rectangular scratch or mark upon the cylinder as seen at 37 (Fig. 4). The film is then caused to feed to the right until the cylinder has turned one complete revolution. If the photographic reduction upon the film has been exact in dimensions, a line 38 on the left-hand portion of the film will bisect the rectangle 37 as in Fig. 4. The film carriage will then be set back to the starting position, and caused to travel once more across the machine while the light is turned on so as to effect the photographic transfer of the characters from the film to the cylinder. If, however, the film is slightly short or slightly long the line 38 will not reach the middle of the rectangular mark or will pass beyond it. If the line 38 falls short, then all of the characters on the film are too close together, and if the line passes beyond the middle of the rectangle, then all of the characters are too far apart on the film. Either of these conditions may be remedied, by causing the film to feed faster than the cylinder rotates on the one hand, or slower on the other. This may be done by causing a relative movement of the film frame and carriage in one direction or the other as the carriage is feeding. This relative movement is progressive, and occupies the entire time that feeding is taking place, and causes all of the characters to be transferred to the cylinder correctly spaced laterally.

The mechanism for effecting this adjustment will now be described.

As has been pointed out, the film frame 14 presses at one end against the spring 17, and rests at the other end against the adjusting screw 18. By turning the adjusting screw one way, the film frame may be moved to the left with respect to the film carriage, compressing spring 17. If the screw is turned the other way, the spring, pressing against the frame, moves it in the other direction, following the screw. Integral with the screw 18 is a gear 40 meshing with a rack 41, mounted to slide endwise in grooves 42 in members 43, 44, forming part of the film carriage 8. A bracket 45 is fixed to the back of the rack, and a block 46 is pivotally mounted between this bracket and the rack. A rod 47 pivotally attached at 48 to a bracket 49 fixed to the machine base, passes through a hole in the block 46, and cooperates at the end opposite its pivoted end with a fixed member 50. The rod may be adjusted up and down the scale marked on this member, and may be fixed in position by a setting nut 51. If the rod is set at zero as indicated in dotted lines in Fig. 6, no effect is produced upon the relative feeding speeds of the cylinder and film, but if the rod is set to one side of zero position as shown in full lines in Fig. 6, then as the film carriage moves from left to right, the block 46 is constrained to follow along the rod 47 as its path. This causes a constant movement of the rack 41 in its supporting grooves 42, and this in turn causes a slow and constant rotation of the gear 40 and set screw 18. Thus, the film frame is caused to move constantly to the left or to be moved constantly to the right by spring 17, with respect to the film carriage. If the rod 47 is set to the other side of the zero position, the relative movement of the film frame will be in the opposite direction. As the cylinder is turned by the cord 24 fastened directly to the film carriage, its speed remains constant irrespective of the changes in the rate of feed of the film.

When the operator has adjusted the rod 47 to effect the proper relative rates of feed for the film and cylinder, he sets the carriage to its starting position at the left of the machine as in Fig. 1. He then closes the switch 55, which is held closed by spring-pressed armature latch 59. This supplies

current to the light 35, and at the same time starts the motor 32. The exposure and the feeding then commence. When the carriage reaches the end of its journey, and the photographic transfer has been completed, a projection 56 on the film carriage 8 engages and closes contacts 57, closing a circuit through electro-magnets 58, attracting armature 59, and releasing the switch 55 which is then opened by the downward pull of the weight 60. This shuts off the light and the motor.

Having described my invention, what I claim and desire to secure by Letters Patent is:—

1. In a photographic transfer device, a film carriage, means for supporting a light-sensitive member adjacent to said carriage, means for actuating said carriage and said supporting means in synchronism, and means for adjusting a film carried by said carriage relatively to the carriage while the latter is being actuated.

2. In a photographic transfer device, a film carriage adapted to adjustably support a film, means for supporting a light-sensitized element adjacent to said carriage, means for actuating said carriage and said supporting means at corresponding speeds, and means for adjusting a film in said carriage during said actuating.

3. In a photographic transfer device, a light source, means for feeding a film past said source, means for feeding a light-sensitized member in accordance with the feeding of such film, and means for adjusting the relative rate of feeding of such film with respect to the rate of feeding of such member.

4. In a photographic transfer device, a light-proof shield having an opening therein to admit light, means for feeding a film past such opening, means for feeding a light-sensitized member in accordance with the feeding of such film adjacent to said opening, and means for varying the rate of feed of the film with respect to the rate of feed of such member.

5. In a photographic transfer device, a light source, means for feeding a film past said source, means for rotating a sensitized cylinder in contact with such film adjacent to said source, and means for varying the rate of feed of the film with respect to the rate of rotation of the cylinder while both are in operation.

6. In a photographic transfer device, a carriage, a film holder adjustably mounted in said carriage, a rotatable sensitized cylinder holder adjacent to said carriage, means for actuating said carriage and rotating said cylinder holder at corresponding speeds, and means for variably adjusting said film holder with respect to said carriage during said actuation.

7. In a photographic transfer machine, a carriage, means for moving said carriage, a film frame supported thereby, an adjusting screw for adjusting said frame with respect to said carriage, and means operable by the machine during movement of said carriage for actuating said adjusting screw.

8. In a device for transferring photographs to an initially sensitized cylinder including a carriage supporting a film, a member supporting the sensitized cylinder in contact with the film, and a cable attached to said carriage and wrapped around said member whereby movement of said carriage progressively causes contact of said film and the said cylinder.

9. In a photographic machine in combination, a cylinder, and means for supporting a film in proximity thereto, means for rotating the cylinder and for moving the aforesaid means for displacing the film endwise to the cylinder while the latter is rotating, means associated with the aforesaid means for affording variable and positive rates of drive intermediate the cylinder and the film supporting means whereby variable lengths of film can be coordinated to be completely and exactly exposed upon exactly rotating the cylinder to the extent for one revolution thereof.

10. In a photographic transfer machine, in combination, a cylinder, means supporting a film in proximity thereto, means for rotating the cylinder and for also moving the aforesaid means for displacing the film endwise to the cylinder while the latter is rotating, and means for variably coordinating the driving relations intermediate the cylinder and the film supporting means to provide for traversing variable lengths of film past said cylinder for a fixed and determined extent for circumferential travel of said cylinder.

11. The invention set forth in claim 10 in which means is provided for causing the supplementary progressive movement of the film relatively to the cylinder, which means includes instrumentalities for providing a progression which is uniform throughout the travel of the film.

12. The invention set forth in claim 10 in which means is provided for affording a progressive rearward creep of the film relative to the advancing cylinder and in which means is provided for maintaining the aforesaid progressive rearward creep of the film uniform throughout the travel.

13. In a photographic transferring machine wherein an image from a film is projected upon a sensitized cylinder by traversing the film past the cylinder while the latter is rotated and during exposure of light through the film, in combination with means for permitting preliminary checking of a check point upon the cylinder relatively to a locus upon an end of the film, means for ro-

tating said cylinder and for moving said film at such relative rates that said definite locus shall appear opposite said check upon one complete revolution of said cylinder irrespective of the amount of relative movement between the surface of the cylinder and the film.

14. The method of reproducing the whole image from the film of definite length upon an initially sensitized cylinder, which comprises first contacting one end of said film with the surface of said cylinder and indicating the relative relation of said end of said film upon the surface of said cylinder, then rotating said cylinder and moving said film committantly to the other end of said film, then noting the relative registration of the other end of said film with the previously made indication and repeating the aforementioned steps under different relative rates of travel until such rate of travel capable of bringing said last mentioned end into juxtaposition with the said indication is obtained, and then exposing the film at such last obtained rate.

In testimony whereof I hereto affix my signature.

FRED M. CARROLL.

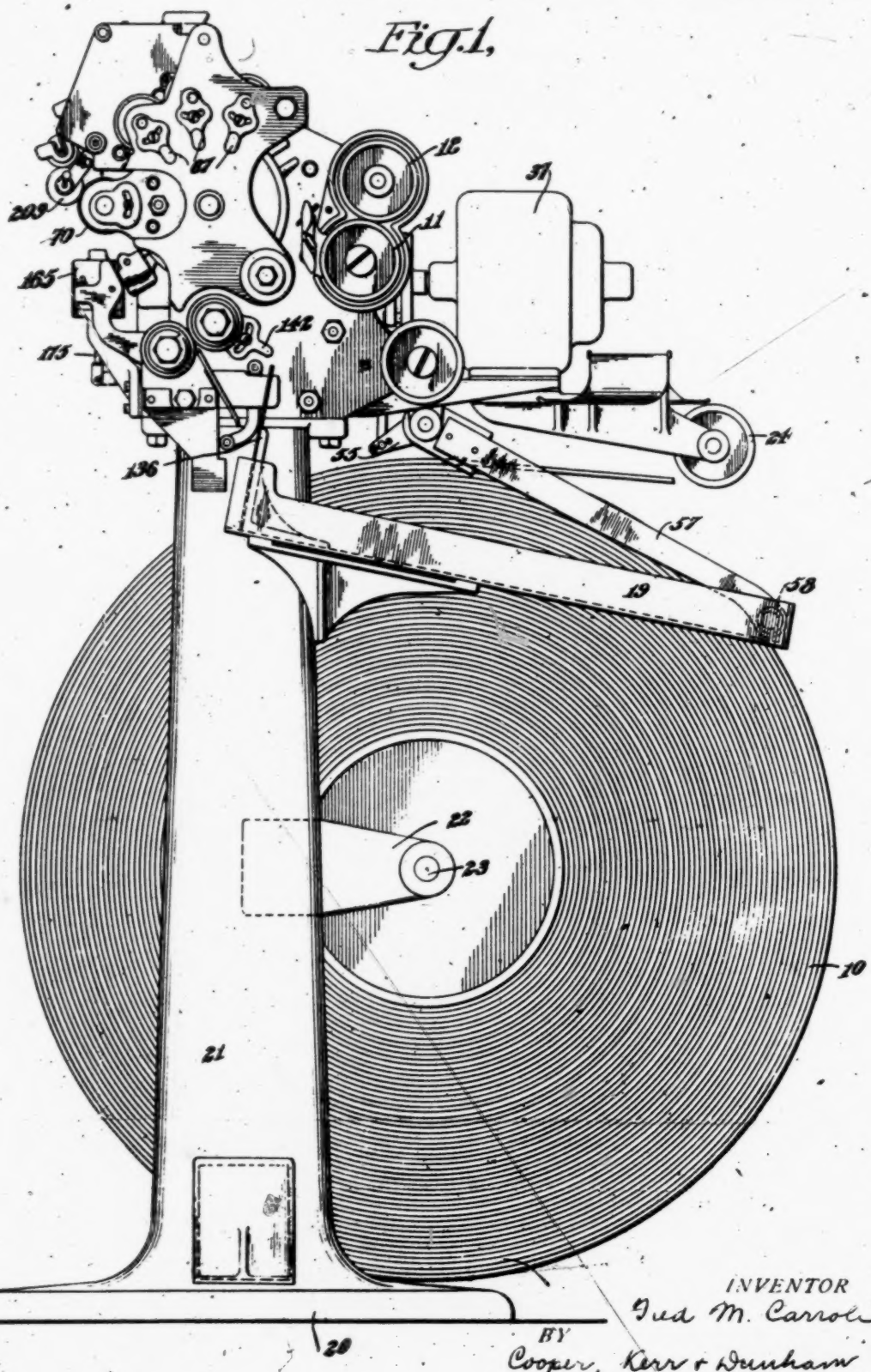
Nov. 24, 1925. 1,563,014

F. M. CARROLL

TABULATING CARD PRINTER

Filed April 14, 1922 15 Sheets-Sheet 1

Fig. 1.



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TABULATING CARD PRINTER

Filed April 14, 1922 15 Sheets-Sheet 2

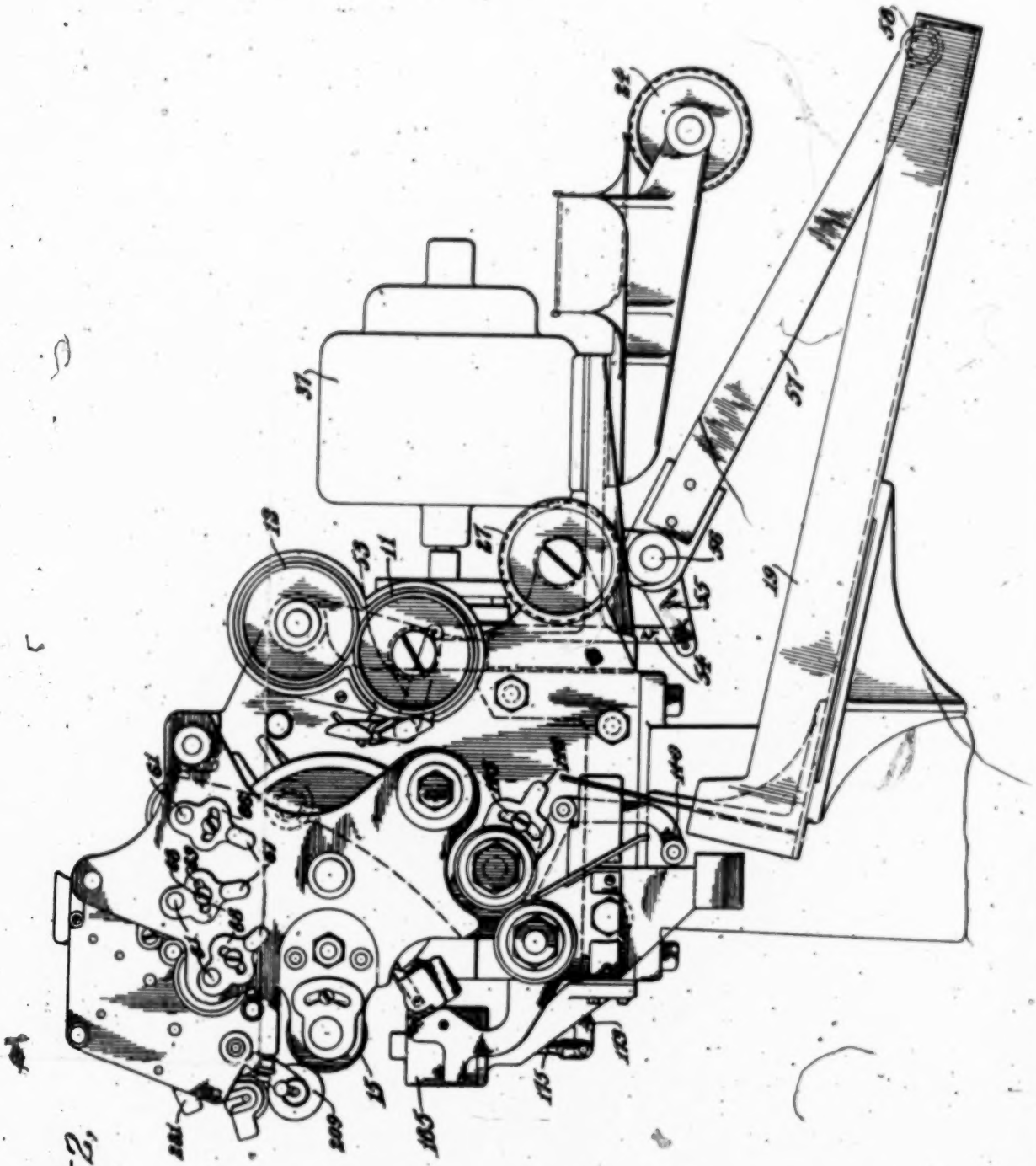

Fig. 2.

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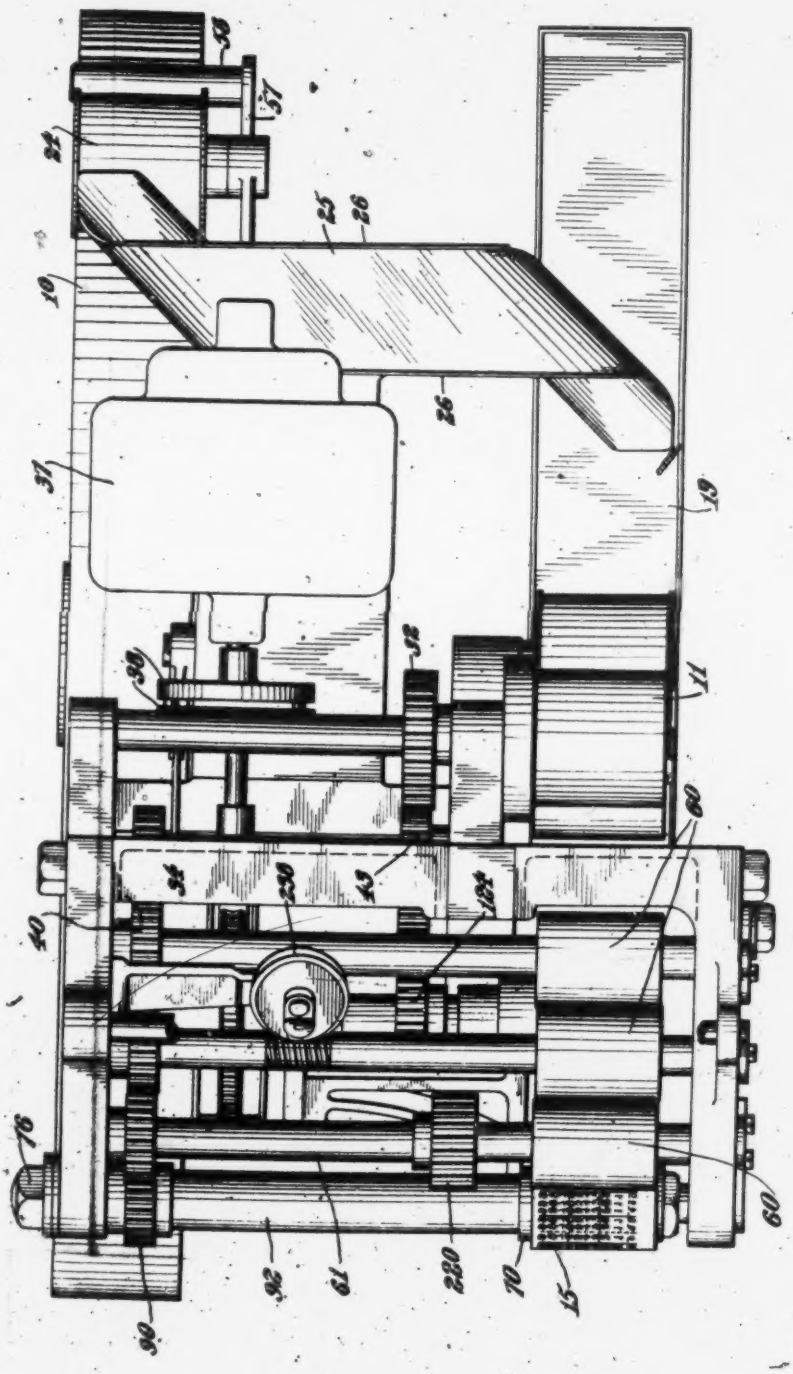

Fig. 3.

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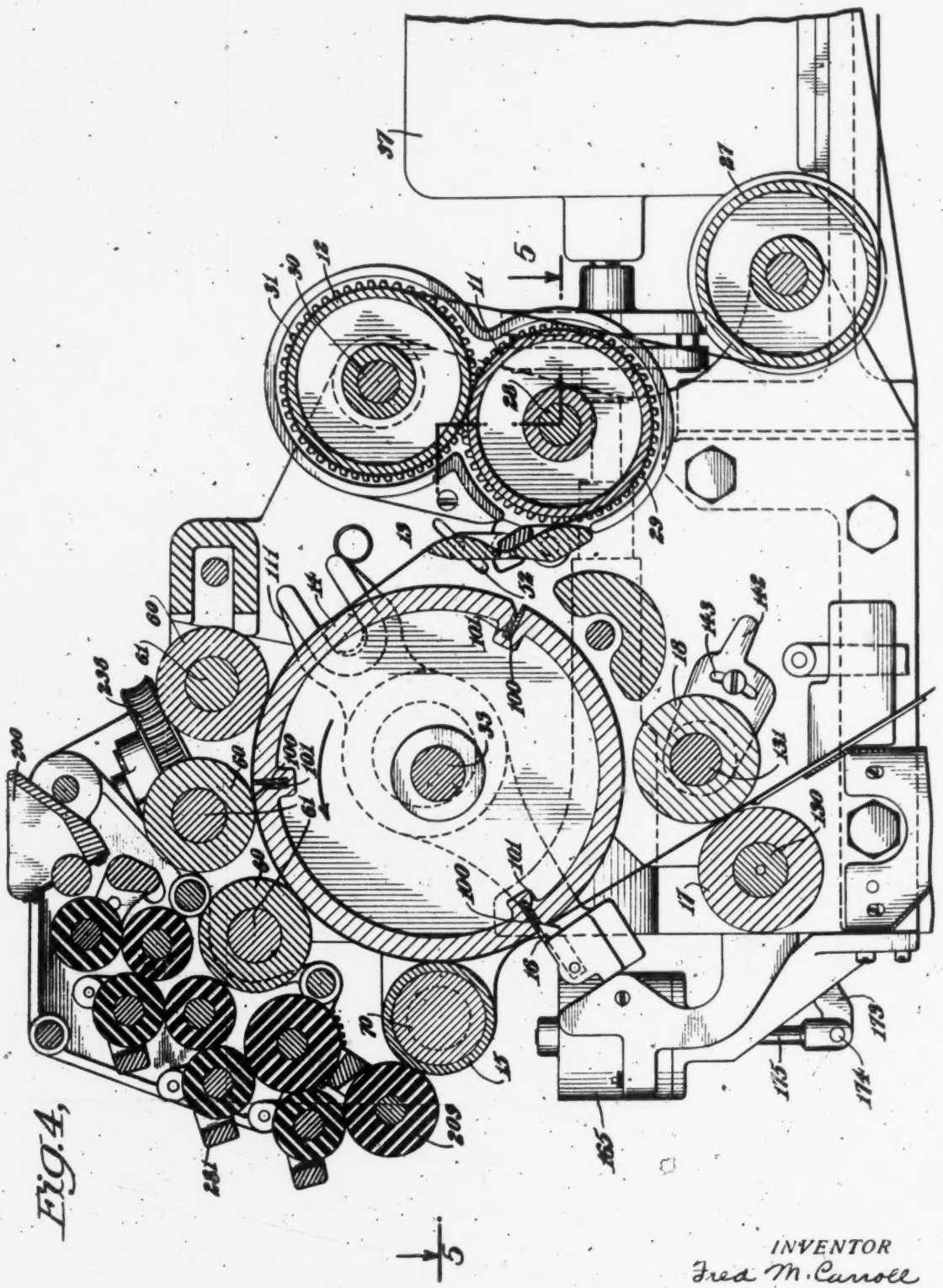

FIG. 4.

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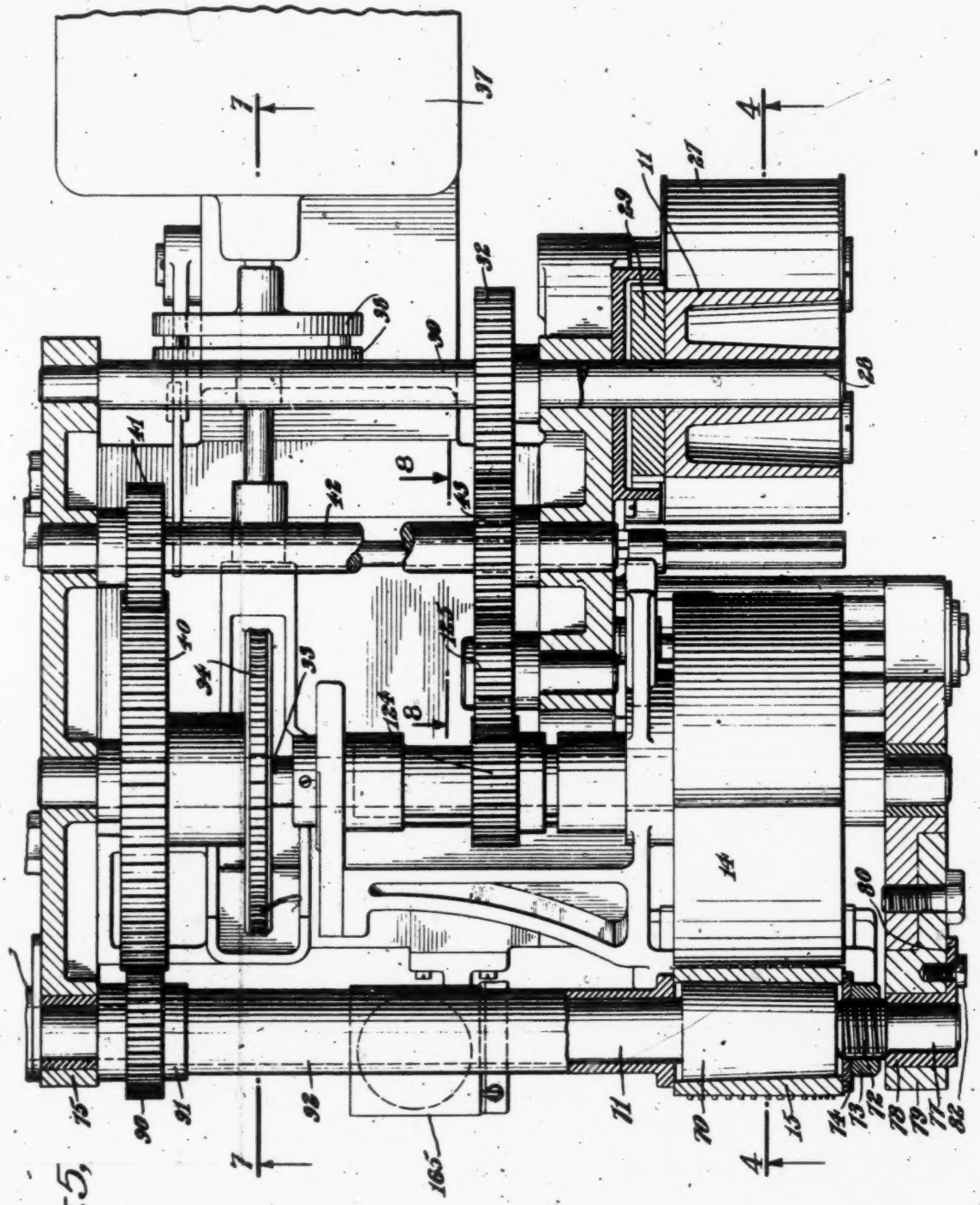

Fig. 5.

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TABULATING CARD PRINTER

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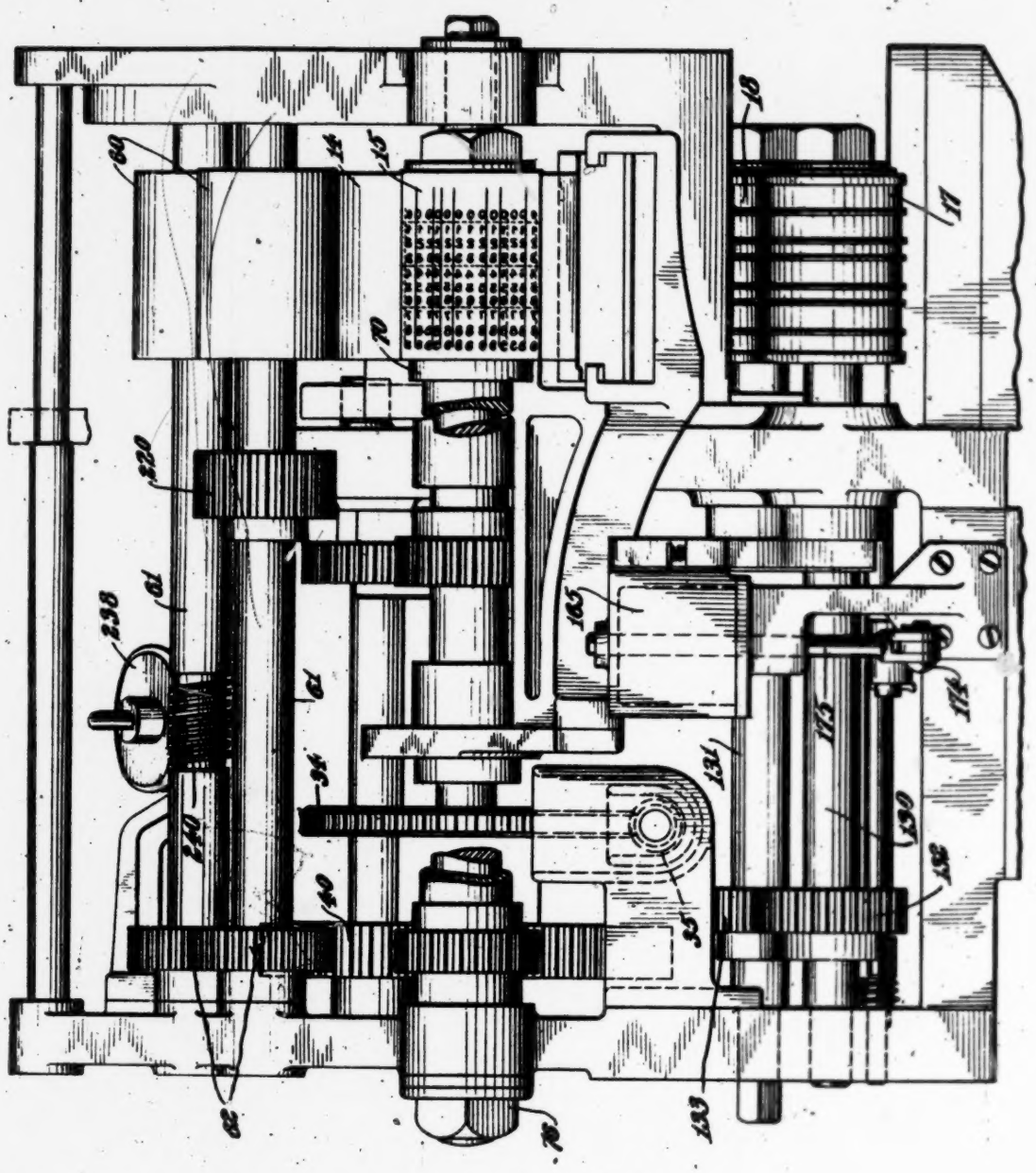

Fig. 6.

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TABULATING CARD PRINTER

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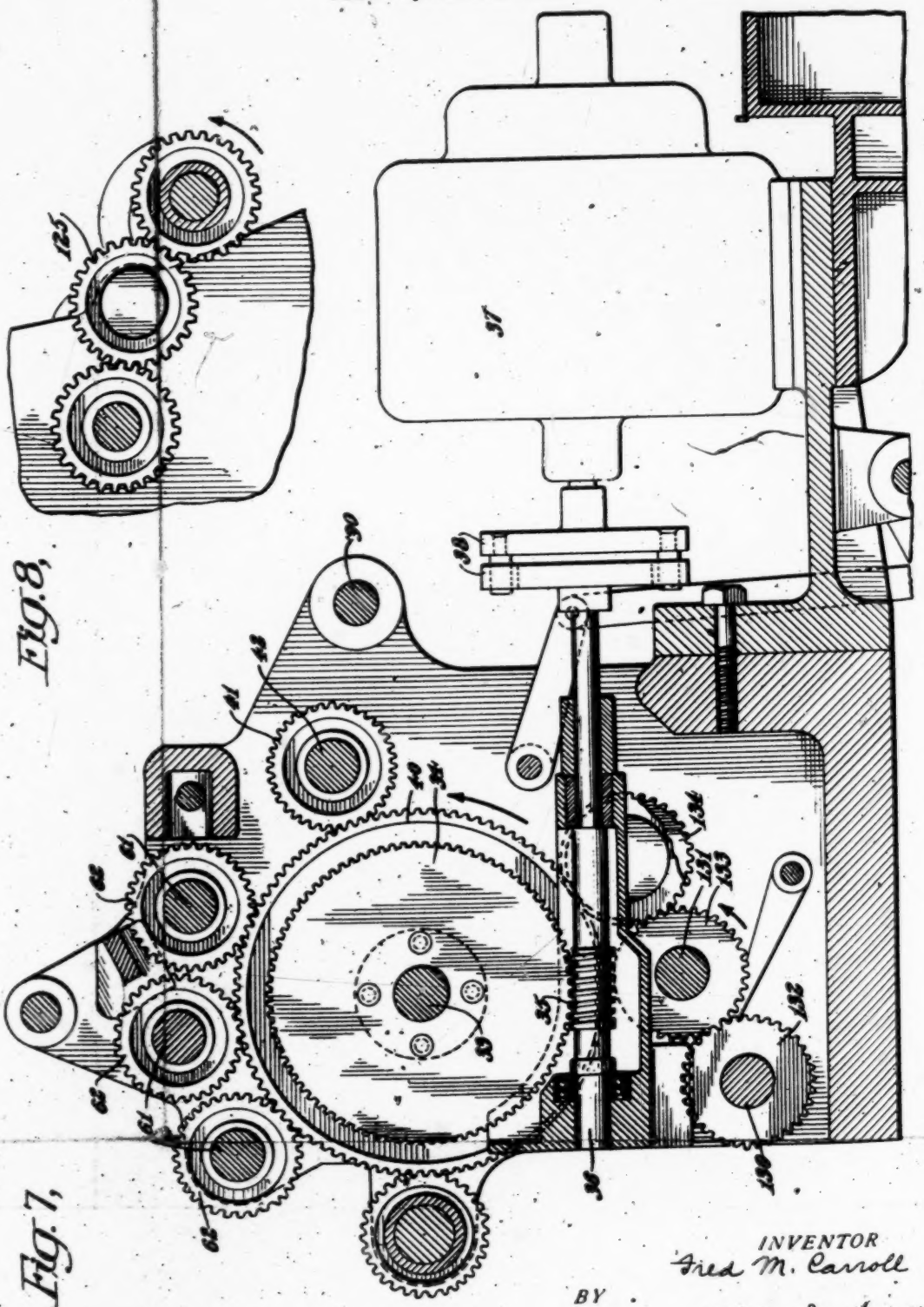

Fig. 8,

Fig. 7,

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BY
Cooper, Kerr & Dunham
ATTORNEYS

Nov. 24, 1925. 1,563,014

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TABULATING CARD PRINTER

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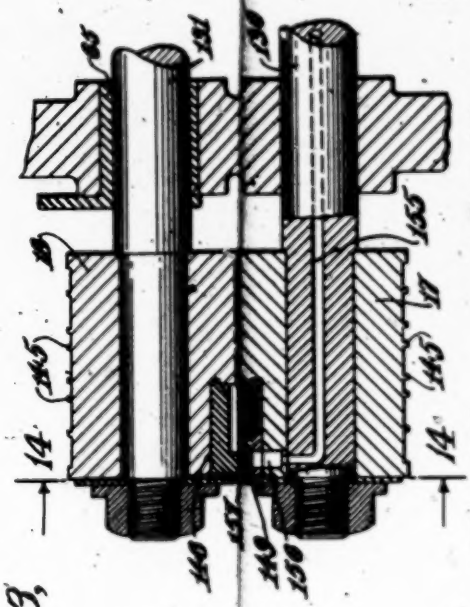

Fig. 13.

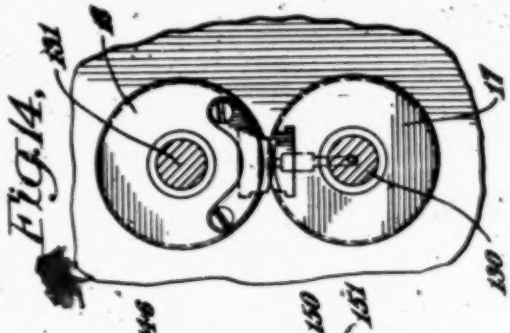

Fig. 14.

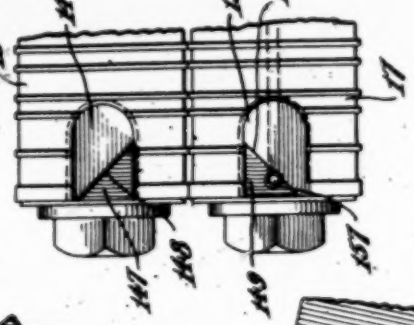

Fig. 15.

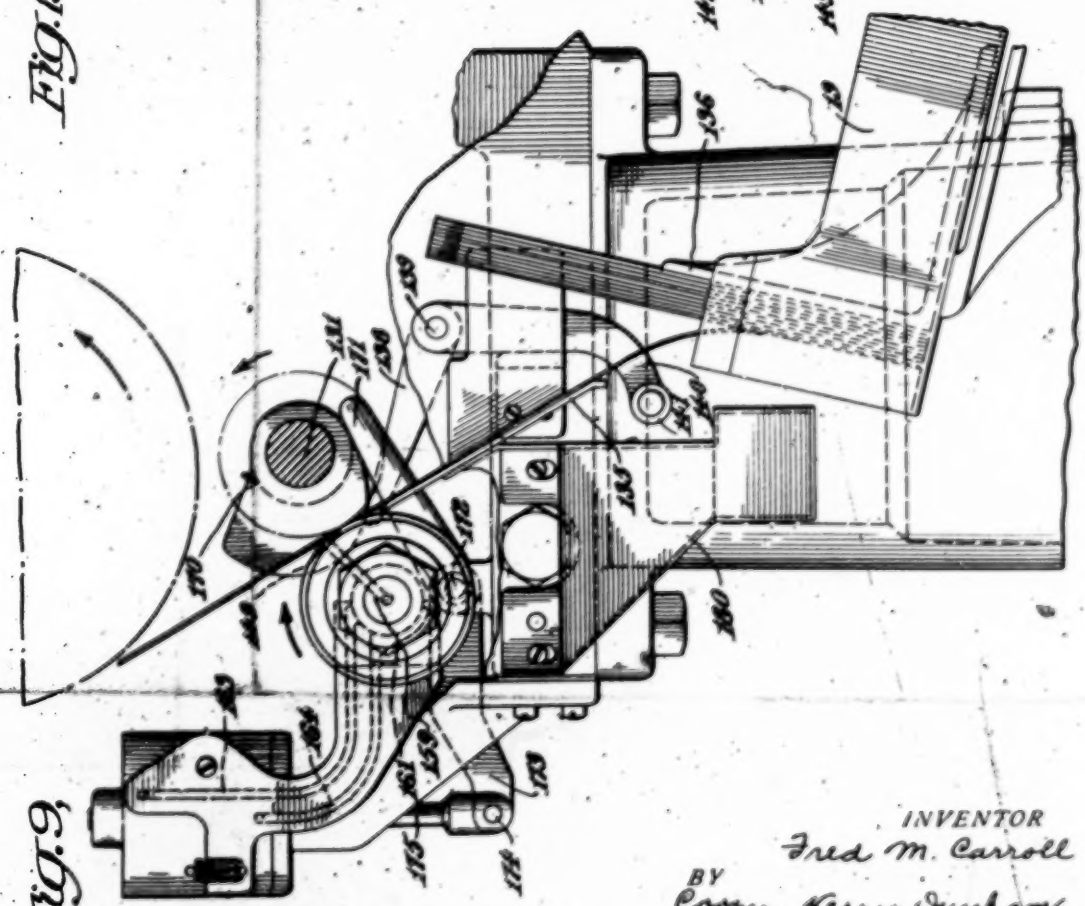

Fig. 9.

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Fig. 11.

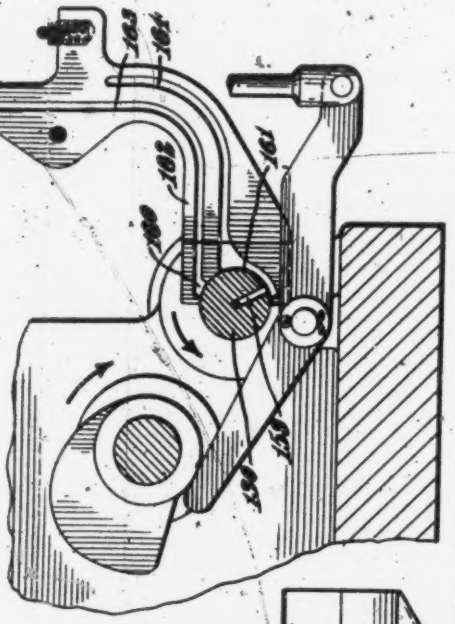


Fig. 12.

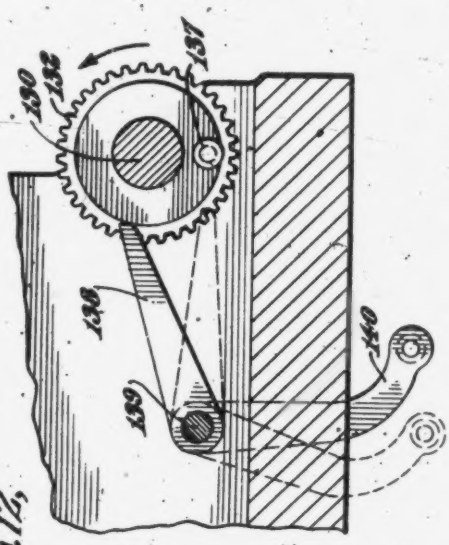
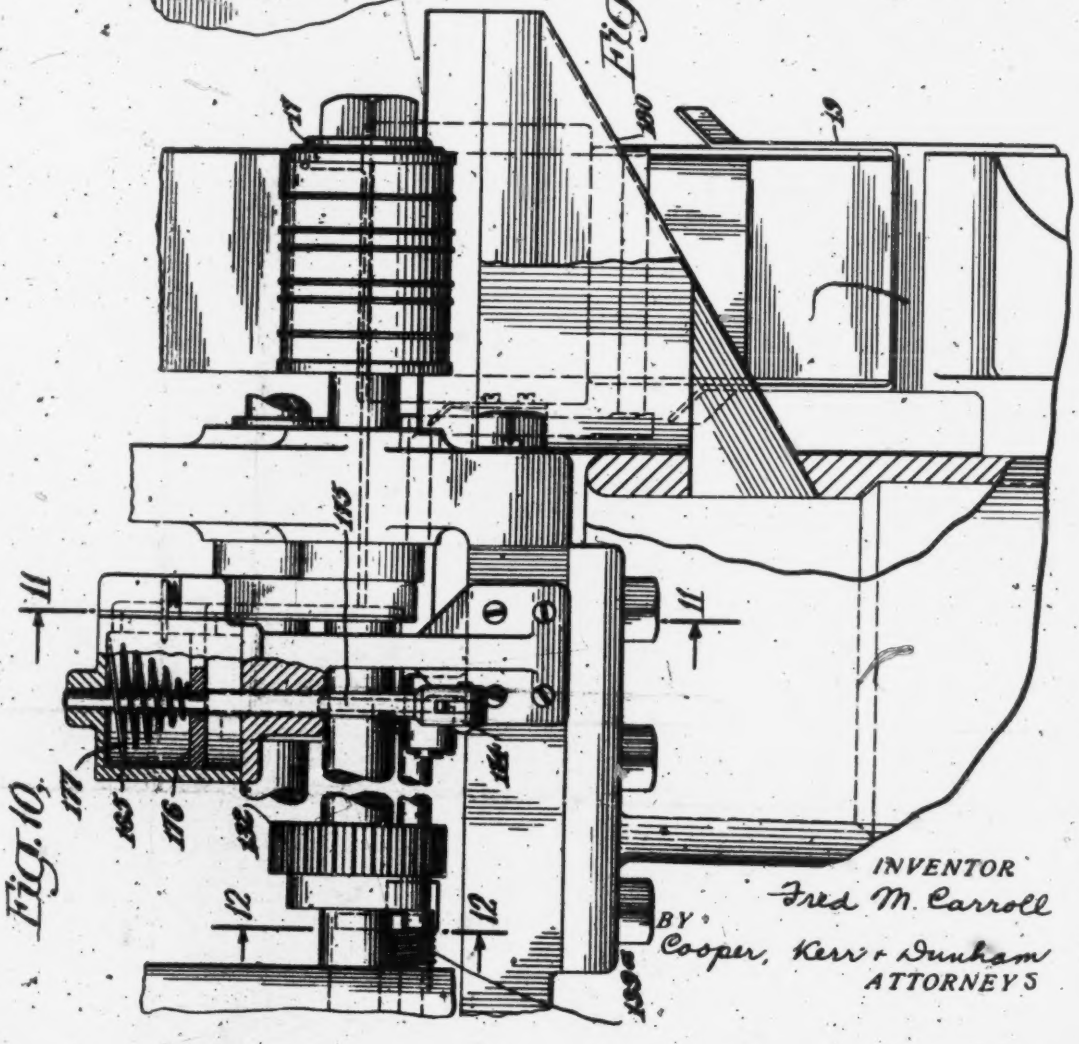


Fig. 10.



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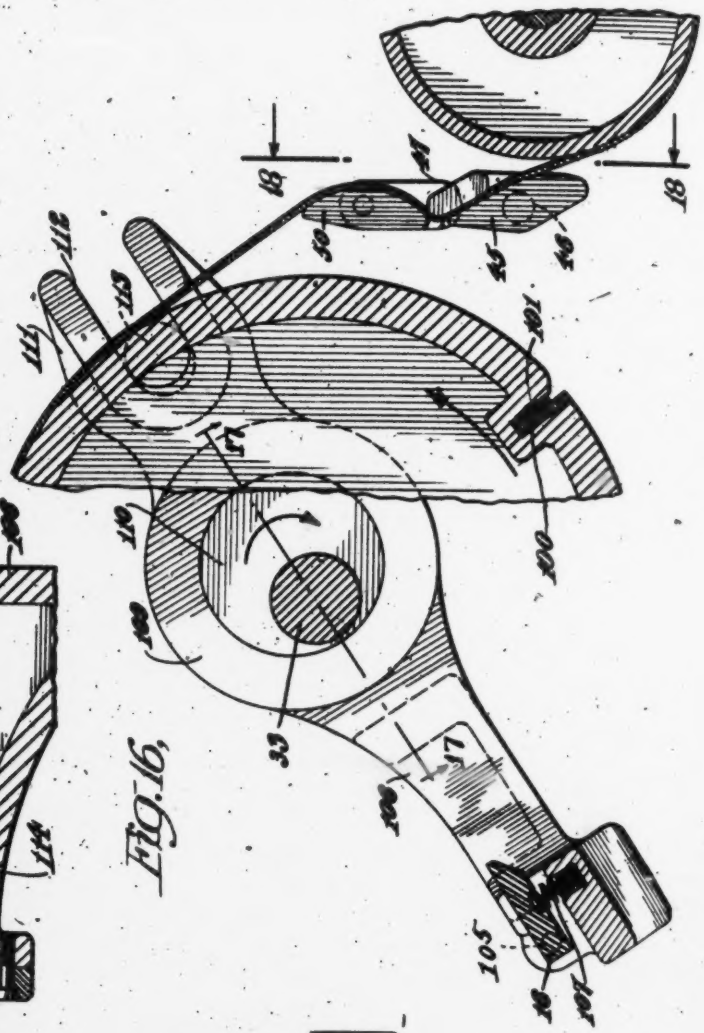

Fig. 16.

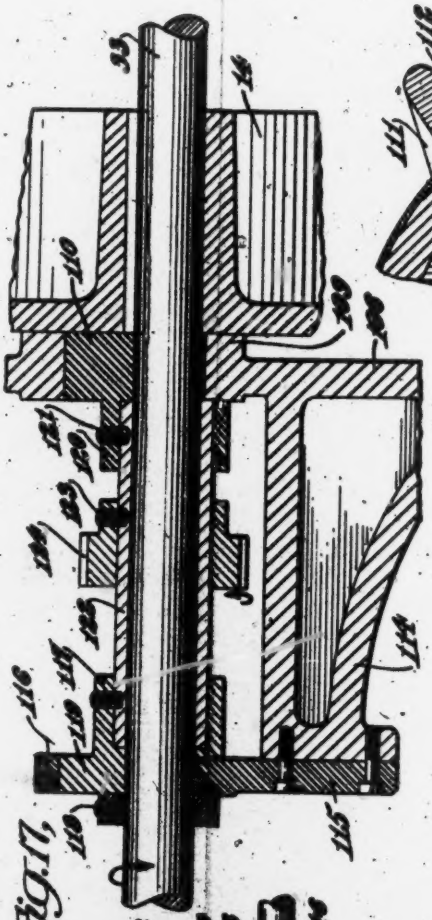

Fig. 17.

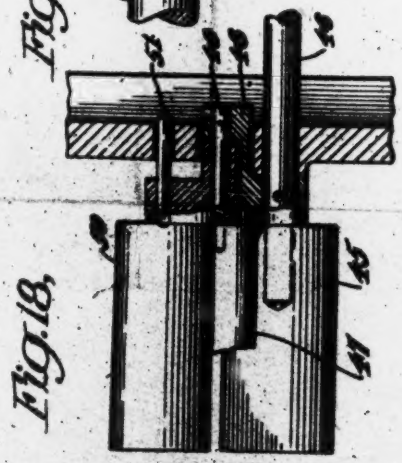

Fig. 18.

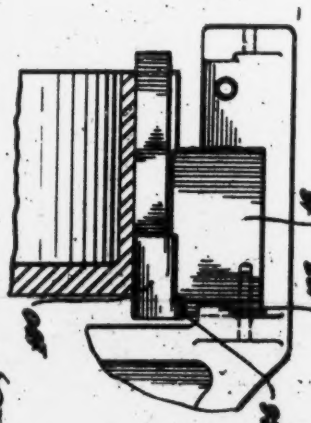

Fig. 19.

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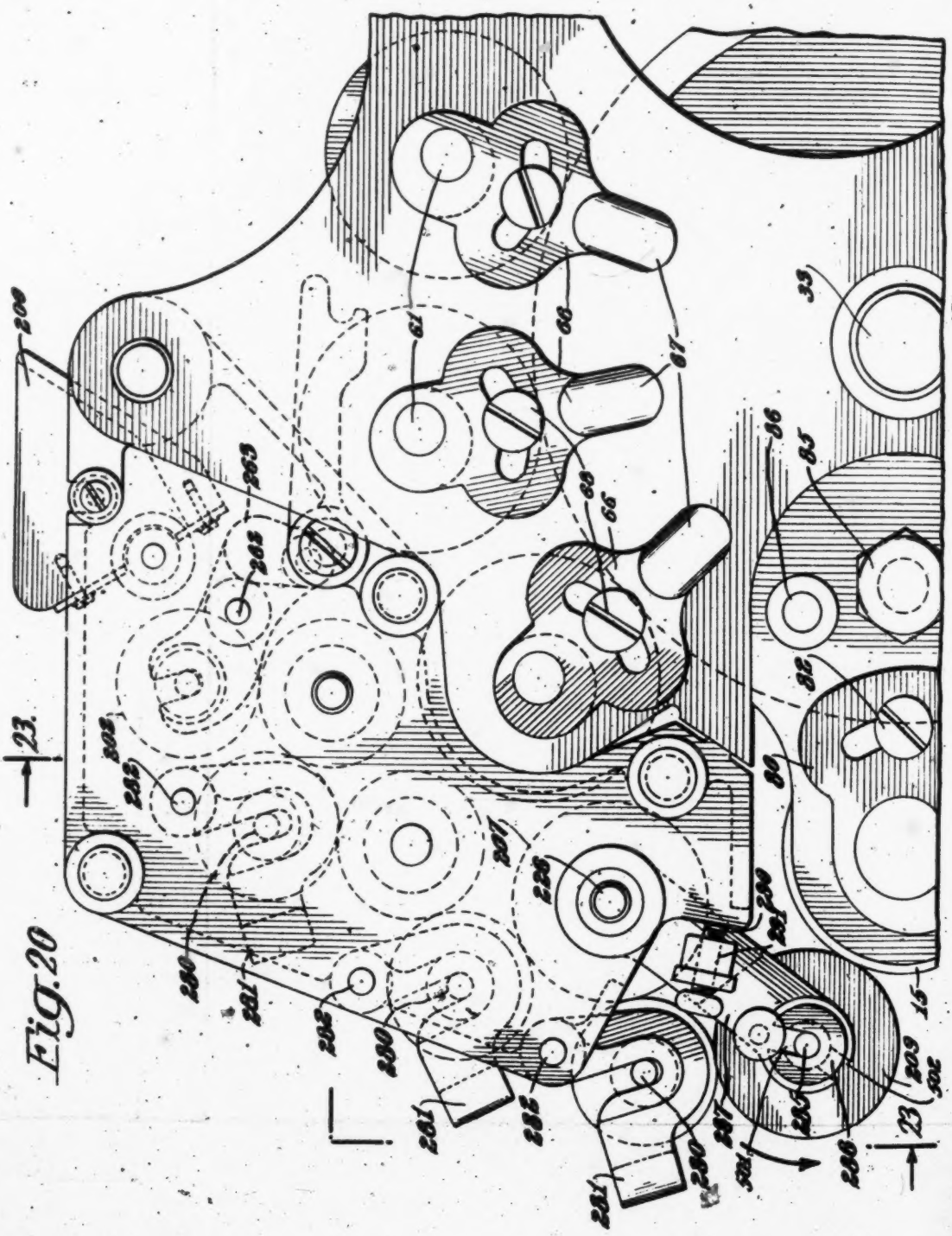

Fig. 20

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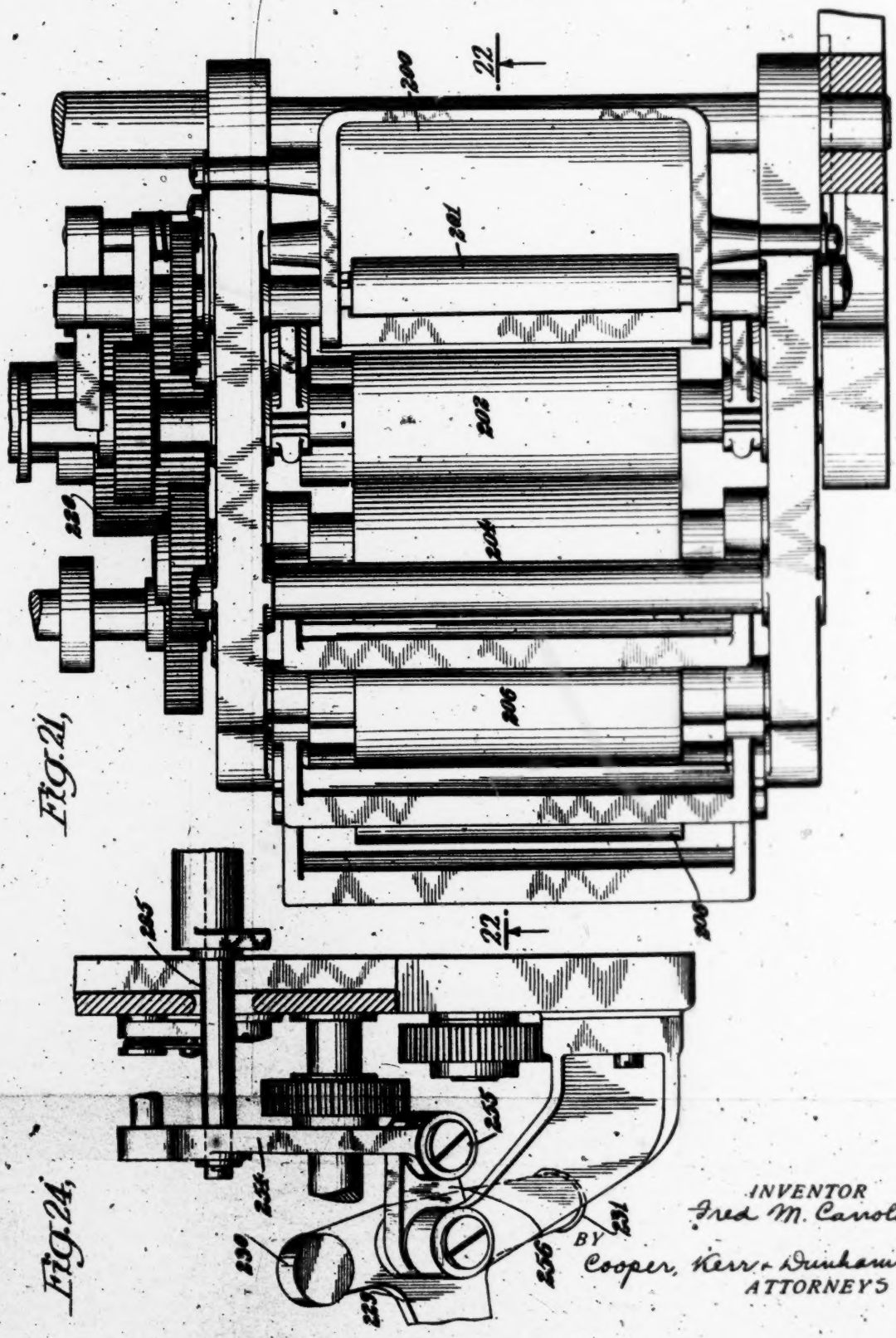

Fig. 21.

Fig. 24.

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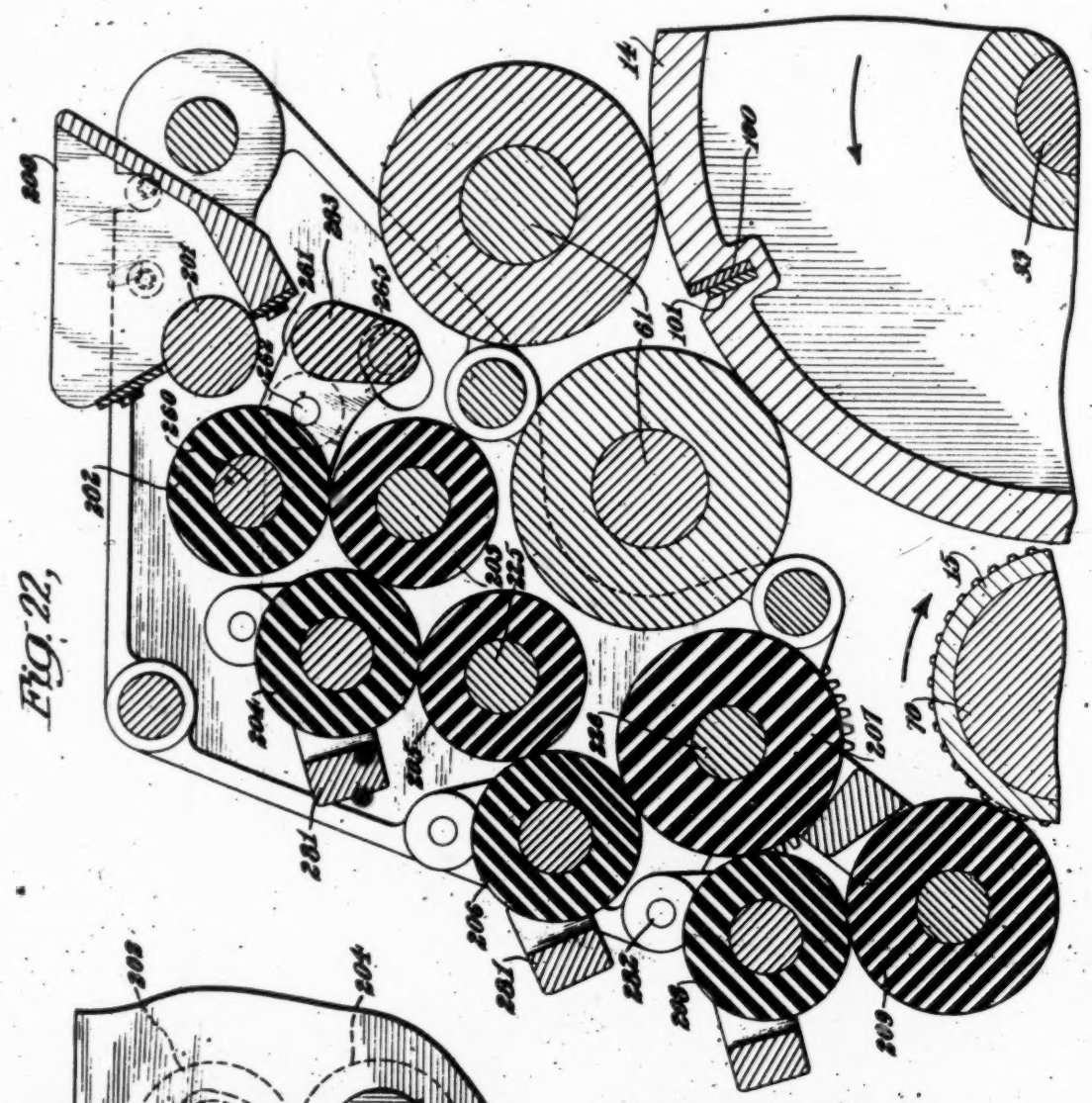

Fig. 22.

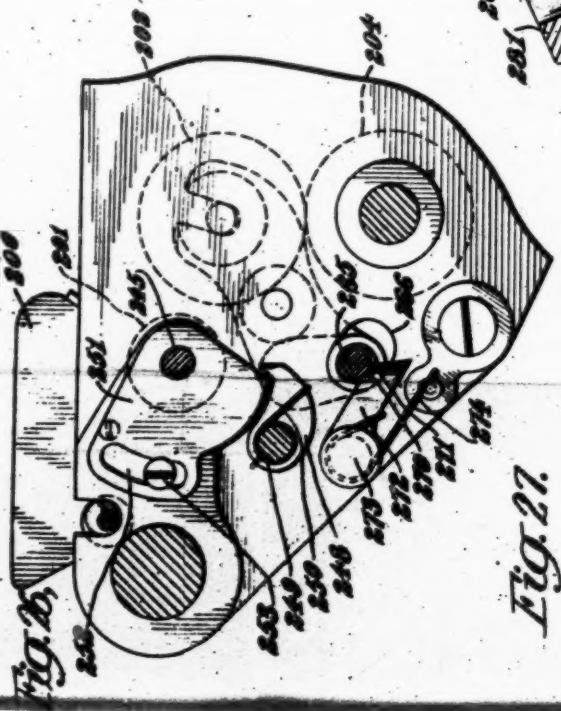

Fig. 25.

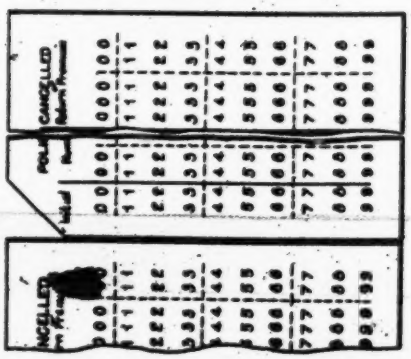

Fig. 27.

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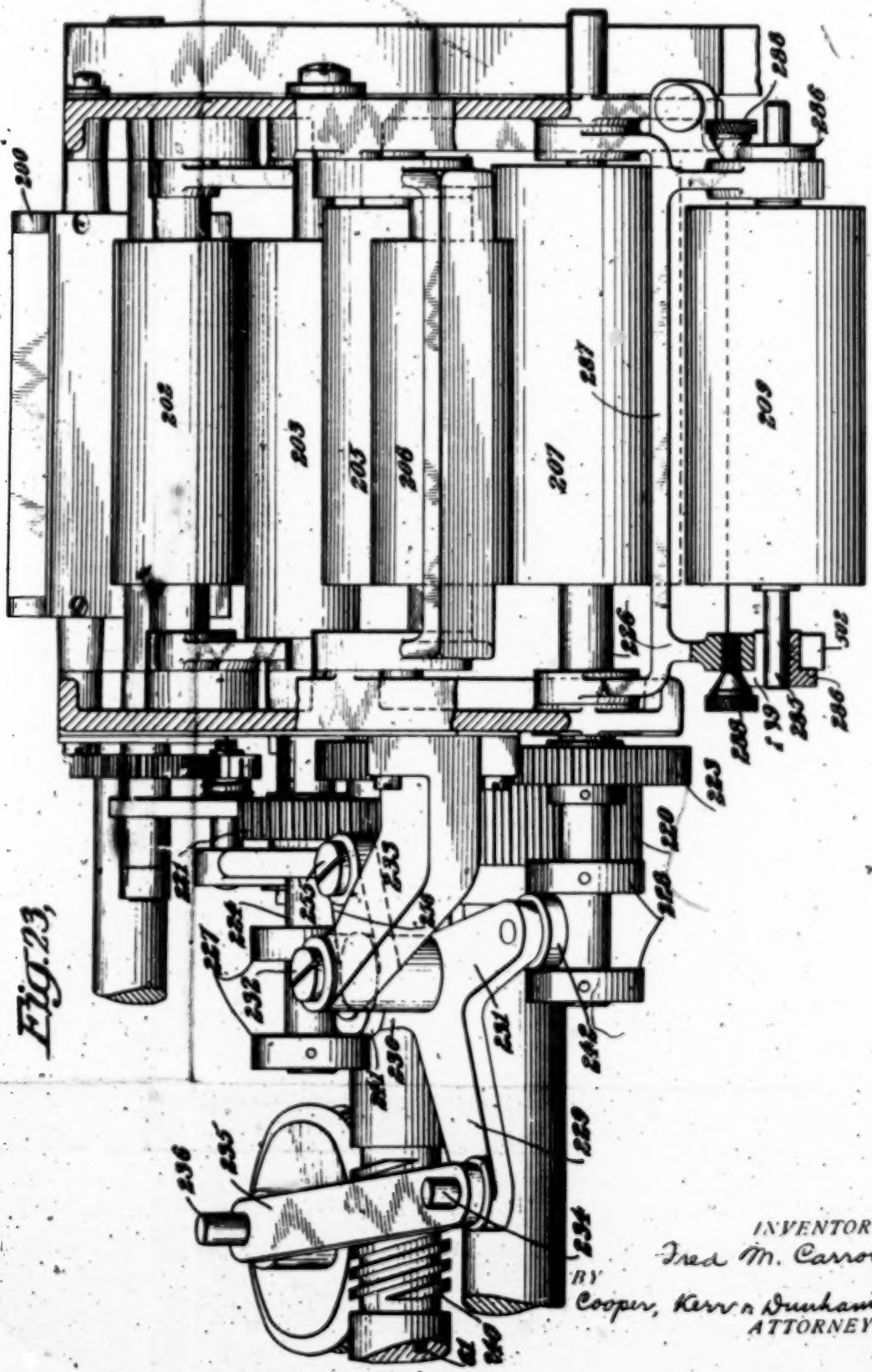

Fig. 23.

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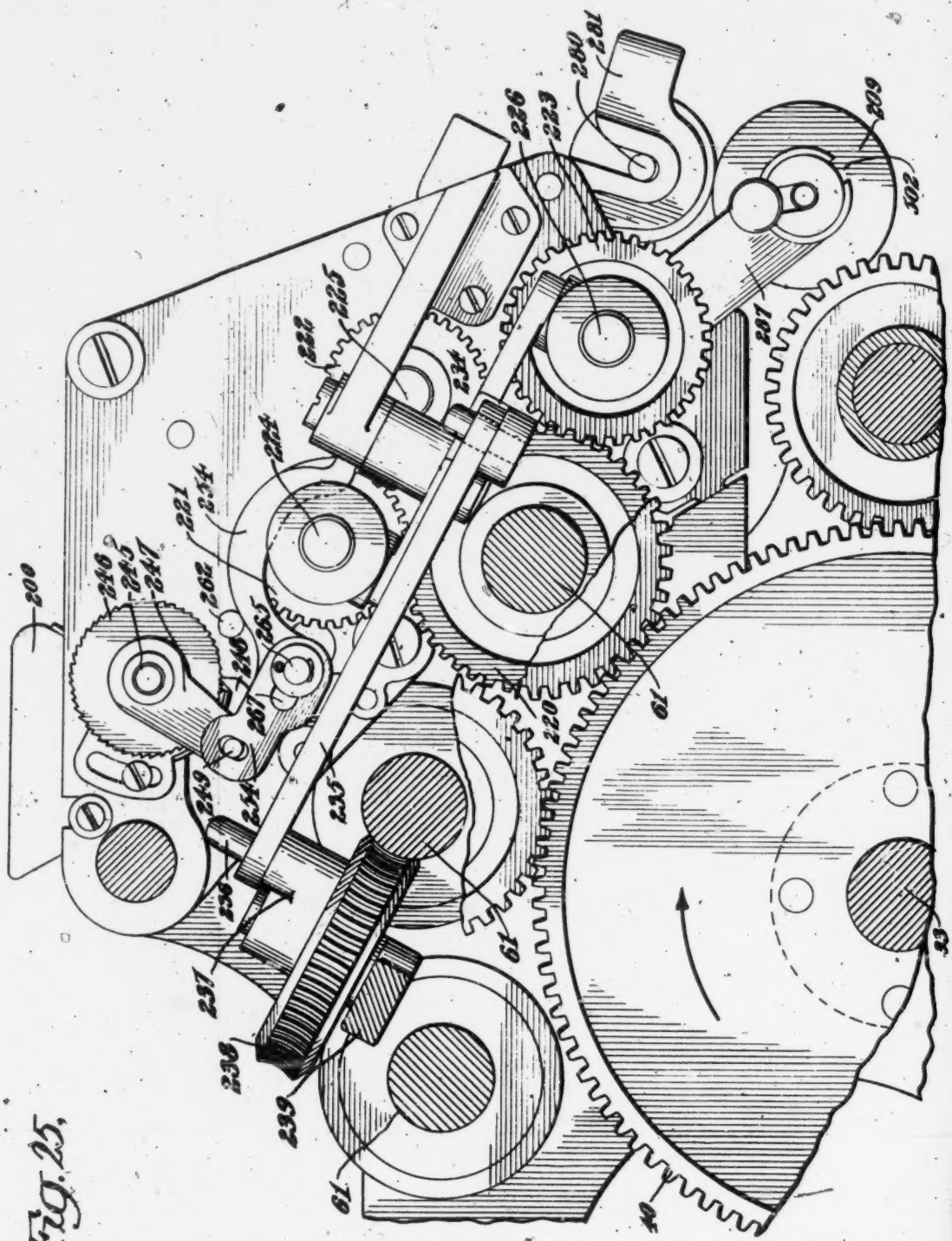

Fig. 25.

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UNITED STATES PATENT OFFICE.

FRED M. CARROLL, OF ENDICOTT, NEW YORK, ASSIGNOR TO THE TABULATING MACHINE COMPANY, OF ENDICOTT, NEW YORK, A CORPORATION OF NEW JERSEY.

TABULATING-CARD PRINTER.

Application filed April 14, 1922. Serial No. 552,654.

To all whom it may concern:

Be it known that I, FRED M. CARROLL, a citizen of the United States, residing at Endicott, in the county of Broome and State of New York, have invented certain new and useful Improvements in Tabulating-Card Printers, of which the following is a full, clear, and exact description.

This invention relates to printing machines. More specifically it relates to card-printing machines and, from a still more specific aspect it relates to machines for printing tabulating cards; i. e., cards to be punched and employed in connection with tabulating machines of the general type illustrated in the United States Patent No. 1,087,061, February 10, 1914, H. Hollerith, and numerous other patents.

One of the principal objects of the invention is to provide a printing machine of increased efficiency and economy and adapted to receive blank material and to discharge accurately printed cards, of accurate size and shape. Other important objects and advantages will appear as the invention is hereinafter disclosed.

Referring to the drawings which illustrate what I now consider a preferred form of machine:—

Fig. 1 is an elevation of the machine.

Fig. 2 is an enlarged elevation of the upper part of the machine shown in Fig. 1.

Fig. 3 is a plan view of the machine shown in Figs. 1 and 2.

Fig. 4 is a sectional elevation taken substantially on the line 4—4 of Fig. 5.

Fig. 5 is a plan view partly in section taken on the line 5—5 of Fig. 4.

Fig. 6 is a detail end elevation of the machine.

Fig. 7 is a sectional elevation taken substantially on the line 7—7 of Fig. 5.

Fig. 8 is a detail elevation taken substantially on the line 8—8 of Fig. 5.

Fig. 9 is a detail elevation, with parts broken away, of a portion of the machine illustrated in complete elevation in Fig. 1.

Fig. 10 is a detail elevation, with parts broken away, illustrating more clearly that part of the machine shown in the lower portion of Fig. 6.

Figs. 11 and 12 are detail sectional elevations taken substantially on the lines 11—11 and 12—12, respectively, of Fig. 10.

Fig. 13 is a detail sectional view taken on a plane through the axes of the card-corner-clipping rolls.

Fig. 14 is a detail end sectional view taken substantially on the line 14—14 of Fig. 13.

Fig. 15 is a side elevation of the structure illustrated in Fig. 14 with the two rolls rotated through 90 degrees.

Fig. 16 is an enlarged sectional detail elevation through certain parts of the machine and including a portion of the main drum cutting or shearing knife, etc.

Fig. 17 is a detail section taken substantially on the line 17—17 of Fig. 16.

Fig. 18 is a detail elevation, partly in section, on the line 18—18 of Fig. 16 illustrating the paper-straightening means employed.

Fig. 19 is a detail view, partly in section, illustrating the card-shearing means and taken substantially on the plane of the line 17—17 of Fig. 16.

Fig. 20 is an enlarged detail elevation illustrating the parts shown in the upper part of Fig. 1.

Fig. 21 is a plan view of the mechanism shown in Fig. 20.

Fig. 22 is a sectional elevation taken substantially on the line 22—22 of Fig. 21.

Fig. 23 is a sectional elevation taken substantially on the line 23—23 of Fig. 20.

Fig. 24 is a detail plan view, partly in section, of certain of the parts shown in Fig. 25.

Fig. 25 is a detail side elevation, partly in section, of the upper portion of the machine.

Fig. 26 is a detail elevation, partly in section, of the upper part of the mechanism shown in Fig. 25.

Fig. 27 is a view illustrating a plurality of finished cards.

Before describing the detailed construction of the preferred form of machine illustrated, I shall explain generally the course

of the material through the machine. The blank material passes from the roll 10 (Fig. 1) over suitable guide devices to and around feed rollers or drums 11, 12 (see Fig. 4). The material then passes through a straightening device, generally designated as 13, and thence around the platen 14. A type roll 15, inked as hereinafter described cooperates with the platen 14 to print the desired subject-matter on the material. A shearing device 16 severs each printed card from its neighbor as the printed material is about to leave the platen. Devices including rollers 18 and 19 receive and remove the cards from the platen and transfer them to the receptacle or tray 19. In certain cases it is desirable to remove the corner of a card. This may be effected by means hereinafter disclosed. I shall now proceed to describe the construction of the various instrumentalities.

The machine comprises a base 20 and pedestal 21 which support the entire mechanism. The pedestal carries journal brackets 22 which in turn support a shaft 23 upon which a roll 10 of blank material is detachably and rotatably mounted. The blank material passes from the roll 10 (see Figs. 1 and 3) over a flanged idler or guide roller 24, journaled on the frame of the machine, thence over a guide plate or trackway 25 provided with side flanges 26, 26, to track the material. By virtue of the structure thus far described, the roll 10 or rolls 10 may be located at one side of the machine. The material passes from the track-way 25 around a flanged idler or guide roll 27 (Fig. 4) suitably journaled in the frame of the machine and thence to the feed rolls 11, 12. The feed roller 11 (Figs. 4 and 5) is journaled on a stud 28, suitably mounted in the frame of the machine, and a spur gear 29 is secured to this feed roller 11. The similar feed roller 12 is secured to a shaft 30 to which a spur gear 31 is also secured, said shaft 30 being suitably journaled in the frame of the machine. The spur gears 29 and 31 mesh with each other so that by rotating the shaft 30 both feed rollers 11 and 12 will be driven to propel the material. The shaft 30 has secured thereto a second spur gear 32 driven by a train of gears hereinafter described.

Calling attention to Figs. 4, 5, 7 and 17, it will be seen that the platen or main drum 14 is secured to a shaft 33 suitably journaled in the frame of the machine. A worm gear 34 also secured to the shaft 33 meshes with and is driven by a worm 35 on a worm shaft 36 which is coupled to the shaft of an electric or other motor 37 through a coupling device 38. The coupling device is shown to be of the pin and radial slot type and effects a readily detachable drive connection between the worm and motor and one which is operative although the worm and motor shafts may be more or less out of alignment. A spur gear 40, co-axially mounted with respect to the worm gear 34 and secured thereto so as to rotate therewith, meshes with a spur gear 41 (Figs. 5 and 7) secured to a shaft 42 suitably journaled in the frame of the machine. The shaft 42 has also secured thereto a spur gear 43 which meshes with the spur gear 32 above referred to as being secured to the shaft 30 of the feed roller 12.

The above described parts including the gearing interconnecting the platen or main drum 14 and the feed rollers 11 and 12 are preferably so designed that the linear or peripheral speeds of the rollers 11 and 12 will be equal to each other but slightly greater than that of the drum 14. By virtue of this design important functions and results are obtained as will hereinafter appear.

I prefer to provide means for removing the curvature or at least a part of the curvature of the material so that the discharged printed cards will be substantially flat or plane. It will be appreciated that the pre-set or curvature of the material will increase as the size of the roll 10 diminishes so that the curvature-removing means should be adjusted to meet this varying condition. I therefore automatically control the adjustment of the curvature-removing-means in accordance with the varying diameter of the roll 10. One form of structure for accomplishing these results is shown in Figs. 1, 2, 4, 16 and 18 and may be constructed substantially as follows:

A bar 45 is secured to a shaft 46, suitably journaled for oscillation in the frame of the machine. A second bar 47 is secured to the shaft 46 in such position that the material will pass between said bars 45 and 47 as clearly shown in Fig. 16. The bar 47 carries a bracket portion 48 to which a stub shaft or pivot pin 49 is secured. A third bar 50 is oscillatably mounted on the pivot 49 and is provided with a pin 51 which passes through the inclined or cam slot 52 (Fig. 4) provided in the frame of the machine. The shaft 46 has secured thereto an arm 53, shown in dotted lines in Fig. 2, to which a link 54 is pivotally connected. The latter is adjustably and pivotally connected at its other end to the short arm 55 of a bell crank lever pivoted at 56 on the frame of the machine. The long arm 57 of the bell crank lever carries a roller 58 which engages the periphery of the roll 10.

Directing specific attention to Figs. 1, 2, 4 and 16, it will be seen that as the roll 10 becomes smaller the shaft 46 and bars 45, 47 will move in a counter-clockwise direction about the axis of said shaft; and the cam slot 52 and pin 51 will cause the bar 50 to move in a clockwise direction about the pivot 49 and with respect to the bars 45, 47. The paper or material will therefore be

bent at a sharper angle as it passes through the straightening device 46—47—50 and the curvature more effectively removed therefrom.

I prefer to employ the drum 14 as a measuring device for the length of cards as well as a platen and it is therefore important that there be no slip between the material and the drum. For this and other reasons I provide a plurality (three as illustrated) of presser rolls 60, 60, 60, each secured to a corresponding one of shafts 61, 61, 61 (Figs. 4 and 6) suitably journaled in the frame of the machine. Each of the shafts 61 has secured thereto a corresponding one of three spur gears 62 each of which meshes with and is driven by the gear 40. It will be noted that each of the rolls 60 rotates in a direction opposite to that of the drum 14 and the design of parts is such that peripheral speed of each roll 60 is equal to that of the drum 14. It is desirable that means be provided whereby the rolls 60 may each be adjusted toward and away from the drum or platen 14. This means may assume the form of eccentrically bored bushings, such as that shown at 65 in Fig. 13, provided, one for either or both ends of the shafts 61 of the rolls 60. Each of these journal bushings is shown provided with an integral plate 66 (Fig. 2) and a thumb or finger piece 67 whereby it may be oscillated. Set screws 68 extending through the slots 69 in the plates 66 permit adjustment and provide means for holding the parts in adjusted position. Obviously by moving the members 67 in the proper one of opposite directions the shafts 61 and rollers 60 may be caused to approach or recede from the drum 14. I shall now describe the type roll 15 and the means for actuating the same, attention being directed to Figs. 3, 4, 5, 6 and 20.

The type roll 15 is shown in the form of a sleeve provided with a tapered bore adapted to receive the frusto-conical portion 70 of the shaft 71. The latter is screw-threaded at 72 to receive a nut 73 which, together with the washer 74, provides a means for removably securing the type roll to the said shaft 71 and provides for register-adjustment of said type roll 15. One end of the latter is journaled at 75 in the frame of the machine and is threaded at its reduced outer end to receive a nut 76 whereby it may be held against endwise movement with respect to the frame and yet be removed therefrom when desired. The opposite end 77 of the shaft 71 is shown journaled in the cylindrical bore of an adjusting bushing 78. The exterior of the latter is cylindrical but its shaft-receiving bore is not co-axial but is eccentric with respect to the outer cylindrical periphery of the said bushing. The latter is rotatably mounted in the bracket 79 and is provided with an integral plate 80 having a slot 81 through which a set screw 82 extends. In view of the description set forth in connection with the generally similar parts associated with the presser rolls 60, it will be obvious that, by virtue of the elements 78 to 82, the type roll 15 may be adjusted toward or away from the drum 14 and held in adjusted position. The bracket 79 is preferably detachably connected to the frame of the machine as by means of one or more cap screws 85 and one or more dowel pins 86. By constructing the dowel pins and the corresponding holes which receive them of hard metal, and accurately machining them a means is provided whereby the bracket 79 and supported parts may not only be removed but readily restored to exactly the same position as was occupied before such removal. The shaft 71 has secured thereto a spur gear 90 which meshes with and is driven by the gear 40 so there will be no slip between the type carried by the sleeve 15, and the periphery of the drum 14. The hub 91 of the gear 90 abuts against the frame portion 75 and also serves to limit the endwise movement of a sleeve 92 which surrounds the shaft 71 and abuts at its other end the type roll 15.

Before or at the time the material leaves the drum 14 it is cut or sheared to form cards of the desired dimension (length in this case). The shearing mechanism is automatic and accurate in its operation and is preferably constructed as follows. (See particularly Figs. 4, 5, 6, 8, 16, 17 and 19.)

The drum 14 is so designed that its circumferential or peripheral length is an exact multiple of the desired card length. In the present case the circumferential length of the drum 14 is three times the card length. The drum is provided with three equi-angularly spaced knives 100 whose outer leading edges are straight and parallel with respect to the axis of the drum 14 and form cutting edges. It will be understood that the drum 14 is suitably grooved to receive the knives 100 and the latter may be removably held in position by means of wedge blocks or plates 101. The movable knife 16 is adapted to coact with each of the knives 100 at the proper time in the cycle of operation to perform the card-shearing operation. Means are provided for automatically actuating the knife 16 to perform this function and may be constructed as follows:

The knife 16 is pivotally mounted at 105 on a lever 106 so as to be capable of a slight degree of pivotal movement with respect thereto. The knife or blade 16 is biased in a counter-clockwise direction about its pivot 105 by means of a compression spring 107 and the extent of such movement is limited by the engagement of the knife with the laterally projecting lug 108 provided on the lever 106. The latter is provided with a

bearing portion 109 forming an eccentric strap surrounding and adapted to cooperate with an eccentric 110 mounted upon but rotatable with respect to the shaft 33 of the drum 14. The end 111 of the arm 106 is slotted as indicated at 112 to slide on a pin 113 secured to the frame of the machine. It will be seen that rotation of the eccentric 110 will so move the lever 106 as to cause the knife alternately to approach and recede from the drum 14, the path of movement of the knife 16 being substantially an ellipse. In order to aid in supporting and operating the arm 106 in its above described movement, a lateral extension 114 is provided on the lever 106 and this extension has detachably secured thereto (Fig. 17) a member 115 which forms an eccentric strap 116 for an eccentric 119 secured to the sleeve 122 in a manner similar to the securing of the member 110.

The means for driving the eccentric 110 may be constructed as follows.

The hollow hub 120 of the eccentric is operatively connected, by means such as set screw 121, to a sleeve 122 surrounding but rotatable with respect to the shaft 33. Endwise movement of the sleeve 122 is limited by abutment with the members 110 and 117 into which the sleeve extends. The sleeve 122 has also secured thereto, by suitable means such as a set screw 123, a gear 124. This gear 124 (Figs. 5 and 8) meshes with an idler gear 125 which in turn meshes with and is driven by the gear 43, hereinbefore described as being driven by the gears 40, 41. It will be noted that each of the knives or blades 100 is provided with a radially-outward-projecting lug 126 (Fig. 19) which is provided with a beveled surface adapted to be engaged by the knife 16. It will be noted further that the cutting edge of the knife 16 is in the same plane with but is not parallel to the axis of the drum 14 (Fig. 19) so that the shearing commences at one edge of the card material and proceeds across to the opposite edge.

The above described parts are so designed that before any knife 100 reaches the position occupied by the lower left hand knife 100 in Fig. 4 its lug 126 is engaged by the knife 16 and cams the latter into proper shearing alignment with respect to the adjacent knife 100. As the movement of parts proceeds the knife 16 moves substantially radially inward to shear the card material until the innermost position of the knife 16 is reached, at which time the material is cut across its entire width. As the movement of parts proceeds further the knife 16 is moved away from the drum and ultimately, and at the proper time, contacts with the lug 126 of the next knife 100, and so on.

Before any card has been severed from the remainder of the material its leading edge will have passed between the rollers 17, 18, and gripped thereby. For reasons hereinafter stated these rollers 17 and 18 are preferably so driven and so timed that they will present the same points on their peripheries to any card entering between them as they do to any other card so entering but their linear peripheral speeds are slightly in excess of that of the drum 14. It will be seen that these two requirements are not inconsistent and are readily obtainable, the first being a function of angular velocities and the second a function of angular velocities of rolls 17 and 18 and the radii of the latter. I shall now proceed to describe the driving means for the rollers 17 and 18, having specific recourse to Figs. 4 and 7 for this purpose.

The rollers 17 and 18 are each secured to a corresponding one of the shafts 130, 131 suitably journaled in the frame of the machine. Each of the shafts 130, 131 has secured thereto a corresponding one of identical gears 132 and 133 which mesh with each other. The gear 133 meshes also with a suitably journaled idler gear 134 which in turn meshes with and is driven by the gear 40. The rollers 17 and 18 are preferably provided with card-corner-clipping devices. Before proceeding to describe these devices, I shall describe the means for conveying the cards to the receptacle or tray 19.

By inspecting Figs. 1, 2 and 9 it will be seen that the cards pass from the rollers 17, 18 over a plate 135, suitably secured to the frame of the machine, and thence into the box or tray 19, secured to and carried by the pedestal 21. The tray 19 is shown provided with a slidable member 136 which is substantially the same in construction and operation as a book rack. As cards accumulate in the tray the member 136 is automatically slid to the right (Figs. 1, 2, 9, 10 and 12) by means now to be described.

The gear 132 of the roller 17 has secured thereto a roller 137 adapted to engage and operate the arm 138 of a bell-crank lever pivotally mounted at 139 upon the frame of the machine. The arm 140 of the bell-crank is provided with a roller 141 adapted to engage the member 136 or the extreme left-hand one of the cards in the tray to propel the same to the right. These parts are preferably so designed that, in the interval of time between the entry of each card and a succeeding card into the tray, the roller 141 is operated to move the member 136, and any cards in the tray, to the right a sufficient distance to make room for the next card. The arm 140 is biased away from the cards by means of a coiled spring 139a (Fig. 10).

Attention is called to the fact that the shaft 131 of the roller 18 is journaled in an eccentrically bored member 65 (Fig. 18)

which is provided with a manually operable member 142, set screw 143, etc., whereby the roller 18 may be adjusted toward or away from the roller 17 and held in adjusted position. In view of the foregoing description of the similar parts 66, 67, 68, 69, etc., no further description is necessary. It will be noted further (Fig. 13) that the card-engaging peripheries of the rollers 17, 18 are provided with annular ribs 145 which are so spaced as to engage the printed card material between the printed columns. In this way smudging or blurring of the printed matter is avoided.

As mentioned above the rollers 17, 18 are preferably provided with devices for clipping the corners of the cards or card material. One form of such device is illustrated in Figs. 13, 14 and 15 in detail. The roller 18 is there shown provided with an insert 146 of steel or other suitable material and having a raised portion 147 providing a diagonal cutting edge 148. The roller 17 is provided with an insert 149 having a raised portion 150 and diagonal cutting edge 151 which are complementary to the elements 147, 148. The design is such that one of the two trailing corners of each card, entering between the rollers 17, 18, is clipped or sheared off by the cooperating cutting edges 148—151. In order to insure that these clippings will not be thrown to such position as to injure the machine or the cards, I preferably provide means for holding each such clipping to one of the rollers 17, 18 until it is in proper position to be discharged therefrom. While the clippings when released from the said roller may be allowed to drop by gravity in certain cases gravity alone may not prove effective. For example, static or frictional electricity may at times cause the clippings to adhere to the rolls. I therefore propose not only to provide means for holding each clipping to the roller until the discharge position is reached but also means for positively forcing each clipping away from the roller when the discharge position is reached. A now preferred form of such means is illustrated in Figs. 9, 10, 11, 13, 14 and 15 and may be constructed substantially as follows.

The shaft of one of the rollers 17, 18, in the present case the shaft 130 of the roller 17, is provided with a duct 155 which communicates at one end with a port 157, in the insert 149, through the port 156 provided in the roller 17. The other end of the duct or passage 155 terminates in a radial branch 159. The latter is adapted to cooperate with the ports 160, 161, provided in a member 162 partially surrounding the shaft 130 and forming therewith a valve as clearly indicated in Fig. 11. The member 162 is provided with ducts or passages 163, 164 leading from the ports 160, 161 to upper and lower ends respectively of a cylinder 165 of a pump which is suitably secured to the frame of the machine. It will be seen that when the parts are in the position shown in Fig. 9 and indeed as long as the port 159 registers with the port 161 communication is established between the port 157 and the lower part of the cylinder 165. At this time the insert 149 moves from the position shown in Fig. 9 to a position below the axis of the roller 17. When the insert 149 and its port 157 are substantially directly below the axis of the roller 17, communication between the lower part of the cylinder 165 and the said port 157 is cut off, and communication between the upper end of the cylinder and the port 157 is established through the following passages: 162—160—159—155—156—157. Mechanism is provided for automatically causing the pump to create a suction or negative pressure at the port 157 when the ports 159—161 are in communication and for providing a positive pressure at the port 157 when the passages 159—160 communicate. I shall now proceed to describe the particular form of such mechanism illustrated in the drawings.

The shaft 131 has secured thereto a cam 170 adapted to engage and operate the arm 171 of a bell-crank lever pivoted at 172 on the frame of the machine. The other arm 173 of the bell crank is connected at 174, by a suitable pivotal connection with the piston rod 175 of the pump. The rod 175 is provided with a shoulder portion (Fig. 10) adapted to engage the lower side of and move the piston 176 upwardly in the cylinder 165. A compression spring 177 biases the piston and connected parts toward the opposite position. The parts are preferably so timed that when the ports 159—161 are in communication the piston 176 is moving upwardly and creating a suction or negative pressure in the lower part of the cylinder and consequently at the port 157. This suction holds the clipping to the roller 17. Communication is established between the ports 159—160 before the piston is permitted to move downwardly. Bearing in mind that upward movement of the piston 176 compresses air in the upper part of the pump cylinder it will be appreciated that when the ports 159—160 communicate a blast of compressed air is discharged through the port 157, thus positively impelling the clipping downwardly away from the roller 17 and into a suitable chute or receptacle 180. The above described cycle is repeated as each clipping of the corner of a card is effected.

Various forms of mechanism may be provided for supplying ink to the type roll 15. I prefer, however, to employ the form of means illustrated generally in Fig. 22 and more in detail in other views hereinafter referred to. I shall first describe the ink-

supply means generally (see Fig. 22). A hopper 200 is supplied with ink. A rotating roller 201 is mounted so as to extend into the hopper and to receive a coating or layer of ink. A rotating roller 202 is oscillated alternately to contact with the roller 201 to receive ink therefrom and with a rotating roller 203 to supply ink thereto. The ink is then transferred, by means of the train of rotating rollers 204 to 209 inclusive, from the roller 203 to the type roll 15. The rollers 202, 204, 206, 208 and 209 are preferably of composition such as that commonly employed for similar rollers in the printing art, while the rollers 201, 203, 205 and 207 are preferably metal. Besides providing means for automatically oscillating the roller 202, as above described, and for rotating the various rollers, I preferably provide means for automatically reciprocating certain of the rollers in axial directions. One form of mechanism whereby these various functions may be accomplished is illustrated in detail in Figs. 4, and 20 to 26, inclusive, and may be constructed substantially as follows.

The shaft nearest the type roll 15 has secured thereto a gear 220 (see also Figs. 3 and 6). This gear 220 meshes with and drives gears 221, 222 and 223 which are each secured to the shafts 224, 225 and 226, respectively, to which the rollers 203, 205 and 207 are respectively secured. The latter are thus rotated when the machine is in operation. The shafts 224 and 226 are not only suitably journaled for rotation in the frame of the machine but are mounted so as to be moved in opposite endwise or axial directions. Spaced collars 227 are secured at one end of the shaft 224 and similar spaced collars 228 are secured at one end of the shaft 226. A T-shaped lever having four arms 229, 230, 231, is pivotally mounted at 232 on a bracket 233 secured to the frame of the machine. The arm 229 is pivotally connected at 234 to a link 235 in turn pivotally connected at 236 to a crank arm 237 connected to and driven by a worm gear 238. The latter is mounted for rotation in a bucket 239, carried by the frame of the machine, and meshes with a worm 240 provided on the middle one of the shafts 61. Obviously when the last mentioned shaft 61 is rotated, the T-shaped lever will be oscillated about its pivot 232. The arm 230 carries a roller 241 which engages both inner faces of the collars 227, 227 and the arm 231 carries a roller 242 which engages both inner faces of the collars 228, 228. Upon oscillation of the T-shaped lever, as above described, the shafts 224, 226 and the inking rollers 203, 207 secured thereto will be reciprocated in axial directions. I shall now proceed to describe the mechanism for rotating the roller 201.

The shaft 245, to which the roller 201 is secured and which is suitably journaled in the frame of the machine, has secured thereto a ratchet wheel 246. An arm 247 is mounted upon the shaft 245 for oscillation with respect thereto and has pivotally connected thereto, at 249, a pawl or dog 248 adapted to engage and operate the ratchet wheel. The pawl 248 is biased toward ratchet-engaging position by a spring 250. A cam plate 251 mounted upon and adjustable about the shaft 245 is adapted to engage the pawl 248 and to govern the length of operative stroke thereof in operating the ratchet. A slot 252, provided in the cam plate, and a cooperating set screw 253 provide means for holding the cam plate in any desired position of adjustment. For oscillating the pawl arm 247, one end of a reciprocatory link 254 is connected to the pivot 249, suitable clearance being provided. The other end of the link 254 is pivotally connected at 255 to an arm 256 secured to the T-shaped lever 229—230—231 (Figs. 23 and 24). Upon oscillation of the T-shaped lever, the arm 256 is oscillated and the link 254 reciprocated to oscillate the pawl arm 247 and thereby rotate the ratchet wheel 246 and inking roller 201 intermittently or step-by-step.

As set forth above, devices are provided for causing the roller 202 alternately to contact with the rollers 201 and 203. The devices illustrated are constructed substantially as follows. The shaft 260, to which the roller 202 is secured is rotatably mounted in a pair of arms 261 each pivotally mounted at 262 on the frame of the machine. The arms 261 are joined by a cross bar or member 263 thereby forming a frame 262—263 in which the roller is rotatably mounted and which frame is oscillatable about the pivots 262. A rod 265 is secured to this frame and extends through a suitable clearance opening 226 in one of the side frames of the machine, and thence through an opening 267 in the link 254. Bearing in mind that the link 254 reciprocates when the machine is operating, it will be appreciated that the rod 265 will be reciprocated (through the lost motion connection illustrated) and the frame 262—263 oscillated. The roller 202 is thus automatically oscillated between and alternately into contact with the rollers 201 and 203.

I prefer to provide mechanism for snapping the roller 202 into contact with the rollers 201 and 203 in a manner generally similar to the action of an electric snap switch. For this purpose, I provide the rod 265 with a knife edge 270 (Fig. 26) adapted to cooperate with the vertex or apex portion 271 of an arm 272, pivoted at 273 on the frame of the machine and strongly biased toward the rod 265 by means of a spring 274. By virtue of the connections above described,

when the roller 202 is being moved by the link 254 from either of rollers 201, 203 toward the other of the said rollers, as soon as the knife edge 270 passes the apex 271 the spring 274 causes the roller 202 to snap into engagement with the roller 201 or 203 toward which it is moving at that particular time.

The rollers 202, 204, 206, 208 and 209 are simply idler rollers in a sense. While they serve as ink conveyers they are not rotated about their axes except by contact with the other inking rollers which they engage. The rollers 204, 206 and 208 are each secured to a corresponding one of shafts 280, 280, 280 which are each rotatably and removably mounted in a corresponding one of frames or yokes 281, 281, 281. Each of the two side members of each of the frames 281 is pivotally connected at 282 to the frame of the machine so that the said rollers 204, 206 and 208 are each biased by gravity into contact with the rollers which they engage. The roller 209 is secured to a shaft 285 rotatably mounted in journals 286 detachably mounted in a frame 287 pivoted on the shaft 226 of the roller 207. The journals 286 are each detachably connected to the frame 287 by means of pin and slot connections of which the pins are in the form of conically-headed set screws 288 each adapted to cooperate with a corresponding one of slots 289. In order to adjust the contact pressure of the roller 209 on the type roll 15, the frame 287 is provided with a lug 291 which is tapped to receive a set screw 290 adapted to engage the frame of the machine.

The operation of the machine may now be summarized as follows, assuming that a roll of blank material has been mounted in the position shown in Fig. 1, the strip threaded through the machine as indicated in Fig. 4, the hopper 200 supplied with ink, and the motor 37 set in operation. The strip of blank material passes from the roll 10, around the roller 24, over the track-way or guide 25, around the roller 27, around the feed roller 12, then around the feed roller 11, then through the straightening or curvature removing means 13, then around the drum or platen 14, between the latter and the type roll 15. The material then passes between the rollers 17, 18 and thence to the tray 19. The presser rollers 60 maintain the material in contact with the drum 14 and prevent any slipping between the material and the last named drum or platen. The peripheral speed of the feed rollers 11, 12 is slightly greater than that of the drum 14 so that there is a certain amount of slip between the material and said rollers 11, 12. These feed rollers 11 and 12, by virtue of their greater linear speed, with respect to that of the drum 14, tend to produce a loop of the material between the lower side of the roller 11 and the straightening device 13 (Fig. 4). This loop is prevented from cumulatively increasing in size because, as stated above, there is slip between the material and the feed rollers 11, 12, when the tension of the material at the exit side of the roller 11 is sufficiently reduced, which takes place upon formation of the loop. Before this loop disappears entirely due to the drawing off by the roll 14, the frictional contact between the material and the feed rollers 11, 12, again becomes effective to cause replenishing of the slack between the roller 11 and the straightening device 13. By virtue of this design the work in moving the material from the drum 10 to the rollers 11, 12 is performed solely by the latter and forms no part of the load upon the drum 14. As the material passes through straightening devices 13 (45—47—50) it is bent to remove wholly, or in part, the curvature or set which it received by being rolled to form the roll 10. The amount or degree of curvature-removing bend so imparted to the material is automatically governed by the elements 53 to 58 to increase the bend as the size of the roll 10 diminishes. When the material passes between the type roll 15 and the drum 14 each card length is printed in accordance with the set-up on the type roll. Ink is automatically supplied from the hopper 200 to the type roll 15 through the train of rollers 201 to 209, all of which rotate and some of which oscillate, as previously described, effectively to feed the ink to said type roll. After each card is printed it is automatically severed from the remainder of the material by the coacting knives 16—100. While each card is being severed it is held taut by the drum 14 and the rollers 17, 18, to which the material passes from the drum 14. As the leading end of each card enters between the rollers 17, 18 one of the corners thereof is clipped or sheared off by the co-operating cutting edges 148, 151. The corner so clipped off is held by suction, created by the automatically operating instrumentalities above described, to the roller 17 until the said clipping reaches substantially the lowermost position on the roller 17 when it is positively driven from the said roller, as previously described, and passes into the receiving chute 180. While the equal angular velocities of the rollers 17, 18 are such as to bring the cutting devices 148, 151 into proper position as each card leaves the said rollers, the peripheral velocities of the said rollers 17, 18 slightly exceeds that of the drum 14. The material between the drum 14 and rollers 17, 18 is thereby kept taut while the knife 16 is performing its severing operation. Furthermore, each card will have been ejected from the rollers 17, 18 before the following card enters said roll-

ers. Passing from the rollers 17, 18, each card enters the tray 19 as shown in Fig. 9 and in the manner previously described. The group of cards in the tray 19 is periodically and automatically moved toward the right to make room for succeeding cards. A plurality of completed cards are shown in Fig. 27. By clipping the corners from the cards, the proper filing and handling of the same is greatly facilitated.

The operation of the machine will now be apparent to those skilled in the art in view of the foregoing disclosure. It is entirely automatic in its operation and possesses many advantages over the tabulating-card-printing machines now in use. It is not only reliable in operation but enables cards to be printed at a much higher rate than is possible with prior machines. I prefer to provide the type on the type roll by a photo chemical engraving process, thereby greatly cheapening the cost of operating the machine. Advantages other than those mentioned above will be apparent in view of the disclosure of the construction and operation of a now preferred form of the machine.

In accordance with the provisions of the patent statutes, I have herein described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiments thereof, but I desire to have it understood that the apparatus disclosed is only illustrative and that the invention can be carried out by other means. Also while it is designed to use the various features and elements in the combinations and relations described, some of these may be altered and others omitted without interfering with the more general results outlined, and the invention, within the scope of the appended claims, extends to such use.

It will be noted that each of the bearings 286 (Figs. 20 and 23) is provided with a slot 501 adapted to register with a corresponding one of two slots 502, provided in the frame 287, when said bearings are rotated through 180° from the position shown in Fig. 23. When the slots 289—502 are brought into registry, as above described, the roll 209 will drop out of the frame without necessitating removal of the screws 288 or the journals 286.

What I claim is:—

1. A printing machine comprising in combination, a rotatable platen, power means for rotating said platen, feeding mechanism for supplying material to said platen and over which said material slips when its tension is relieved, and means for operating said feeding mechanism at a linear speed in excess of the peripheral speed of said platen.

2. A printing machine comprising in combination, a rotatable platen and means for rotating the same, means for severing material on said platen, means for withdrawing printed material from said platen, and means for operating said material-withdrawing means at a linear speed in excess of the peripheral speed of said platen.

3. A printing machine comprising in combination, a rotatable platen and means for rotating the same, feeding mechanism for supplying material to said platen, means for preventing slip of the material with respect to said platen, means for withdrawing printed material from said platen, and means for operating said feeding mechanism and material-withdrawing means at a linear speed in excess of the peripheral speed of said platen.

4. A printing machine comprising in combination, a printing couple, means adapted rotatably to support a roll of material, means for supplying material from said roll to said printing couple, devices interposed between said couple and roll for reducing the curvature of the material, and means automatically responsive to reduction in size of the roll for adjusting the said devices.

5. A printing machine comprising in combination, a printing couple of which the platen is rotatable, means for causing material to travel around and in contact with said platen, means for preventing slip of the material with respect to said platen prior to shearing, and means cooperating with said platen for cutting said material into card-lengths measured by said platen.

6. A printing machine comprising in combination, a printing couple including a platen, means for passing a continuous sheet of material through said couple at a continuous and substantially uniform speed, means for cutting said material into card-lengths upon said platen after it leaves the printing couple, devices for thereafter receiving and removing the material, and means for operating said devices whereby each card is discharged therefrom before the following leading edge of the material is received by said devices.

7. A printing machine comprising in combination, a printing couple including a platen, means for feeding a continuous sheet of material through said couple, means for cutting said material into card-length upon said platen after it leaves said couple, and means for thereafter removing a portion of each card from the remainder of the card.

8. A tabulating-card-printing machine comprising in combination, means adapted rotatably to support a roll of material, a plurality of feed rollers, means for guiding the material to said feed rollers, a rotatable platen around which the material passes, devices interposed between said platen and roll for reducing the curvature of the material, means automatically responsive to reduction in size of the roll for adjusting

said devices, means for rotating said platen and said feed rollers whereby the peripheral speed of the latter exceeds that of said platen, a plurality of pressure rolls for engaging the material passing around said platen, a type roll cooperating with said platen, shearing devices and means for automatically operating the same to cut the material into card-lengths before it leaves said platen, a pair of rollers to which the material passes from said drum, cooperating corner-clipping devices carried by said last-mentioned rollers, means for rotating said last mentioned rollers at a predetermined angular velocity with respect to said drum but at a higher peripheral speed whereby said corner-clipping devices are presented to the trailing end of each card and each card leaves the last named rollers before the following card enters the same, means for automatically holding each corner-clipping to one of said last named rollers until it is clear of the remaining card material, means for thereafter automatically ejecting the clipping from said last named roller, a receptacle into which the cards pass from said two last named rollers, and periodically operated means for displacing the cards in said receptacle to make room for other cards.

9. A printing machine comprising in combination, a printing couple of which the platen is rotatable, means for supplying material to said platen, means for continuously rotating said platen, and means for cutting said material into card-lengths before it leaves said platen, said last named means comprising a knife and means for reciprocating said knife toward and away from said platen and for moving said knife in opposite direction transversely of the line connecting its extremes of reciprocatory movement toward and away from the platen.

10. A printing machine comprising in combination, a printing couple of which the platen is rotatable, means for supplying material to said platen, and means for cutting said material into card-lengths, said last mentioned means comprising a shearing couple of which one element is carried by said platen and the other element of which is movable toward and away from first named element, and means comprising a cam lug carried by said platen for engagement with said second named element to guide the same into shearing position with respect to said first named element.

11. A printing machine comprising in combination, a rotary platen and a rotary impression roll, means for feeding material to said platen, means timed with respect to said platen for accurately cutting the material into card-lengths before it leaves said platen, and means whereby said platen and impression roll may be relatively angularly adjusted to cause the printing to bear a predetermined relationship with respect to the card-length.

12. A tabulator card printer comprising in combination, a printing couple comprising a rotary platen roll and a rotary printing roll, means for feeding a web of material from a supply roll to the rotary platen roll, means for straightening said material before the same is applied to said roll, means for cutting the material into card-lengths after the same has passed the printing roll and while the continuous web is advancing upon the platen roll, and means for withdrawing and delivering the completed cards, said straightening means being adapted to modify the normal curvature of the material sufficiently to permit the delivery of the completed cards in substantially flat condition.

13. A tabulator card printer comprising a printing couple including a rotary platen, means for supplying a web of material to said rotary platen, means for effecting printing thereon while the latter is in continuous motion and means for cutting said web into cards of uniform length, said means comprising a plurality of fixed knives carried by the platen and a movable knife which progressively cooperates with successive of said fixed knives to sever the intervening web of material into cards.

14. A card printing machine adapted to receive a web of material to print thereon and to subsequently sever the web into cards, said machine including a rotary printing couple including a rotary platen, means for applying the web of material to said platen, and for guiding the web partially around the same, and severing means adapted to oscillate around the periphery of said platen and to reciprocate in a direction normal to said periphery, for severing the web into cards while the said web is in contact with said platen.

15. A card printing machine adapted to receive a web of material to print thereon and to sever the web into cards of uniform length, said machine including in combination, a printing couple of which the platen is rotatable, means for supplying a web of material to said platen, a plurality of knife elements carried by said platen, and movable knife means adapted for cooperation with the aforesaid knife elements on said platen and means for imparting a movement of translation to the movable knife means to substantially correspond with the movement of the platen whereby cutting may be effected of the material intervening between the platen-carried knife elements and movable knife devices while the latter are both moving at substantially the same velocity.

16. A card printing machine adapted to receive a web of material, to print thereon and to sever the same into cards, said ma-

chine including in combination, a printing couple including a cylindrical impression roll and a rotatable platen roll, means for driving the same in synchronism, fixed knife means carried by the platen and spaced thereon in accordance with the lengths of cards to be cut, means cooperating with said fixed knife means to sever the web into cards, and means whereby the impression roll may be adjusted with respect to its driving means in order to effect proper registration of the printed impressions upon the cards.

In testimony whereof I hereto affix my signature.

FRED M. CARROLL.

Oct. 14, 1930. F. M. CARROLL 1,778,483

MACHINE FOR OPERATING UPON WEB LIKE MATERIAL

Filed June 15, 1925 5 Sheets-Sheet 1

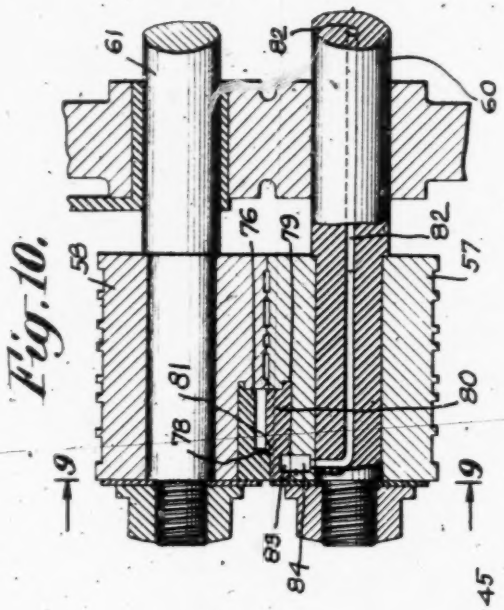

Fig. 10.

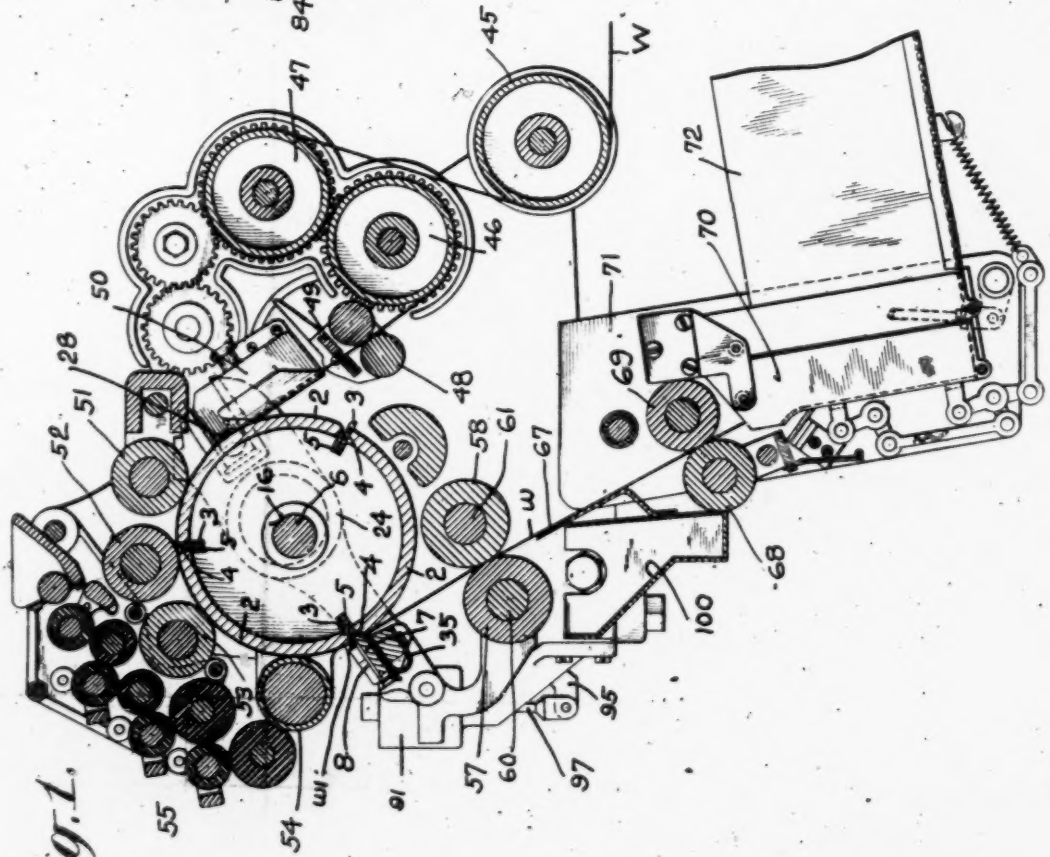

Fig. 1.

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MACHINE FOR OPERATING UPON WEB LIKE MATERIAL

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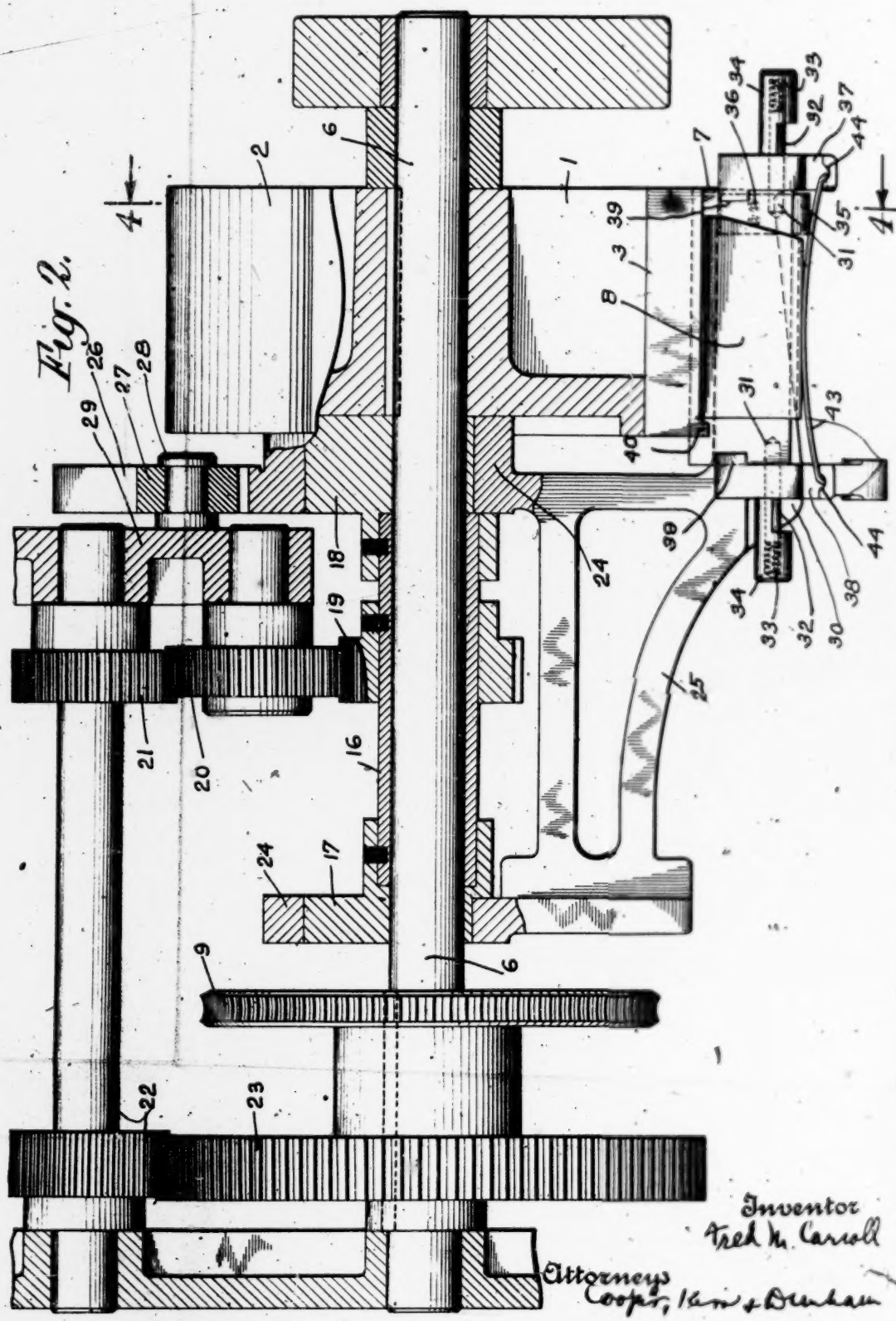
Fig. 2.



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MACHINE FOR OPERATING UPON WEB LIKE MATERIAL

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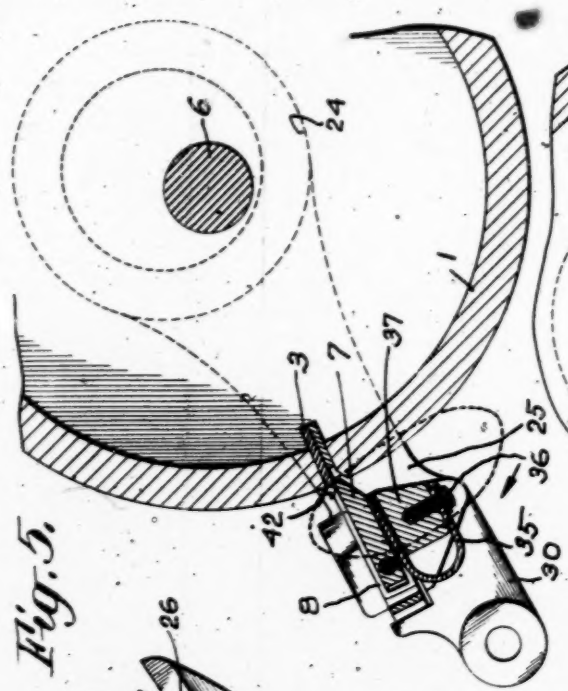

Fig. 5.

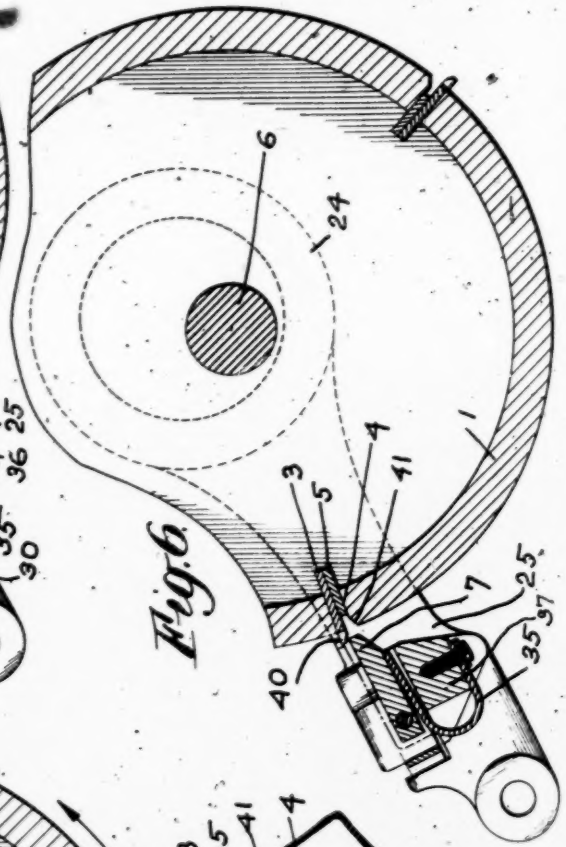

Fig. 6.

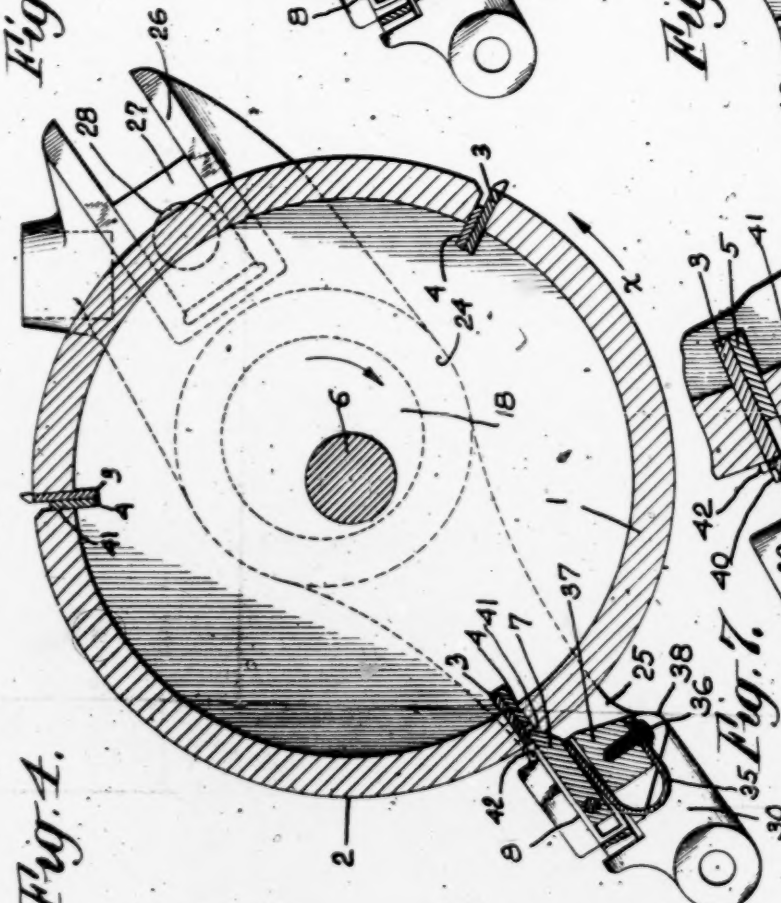

Fig. 4.

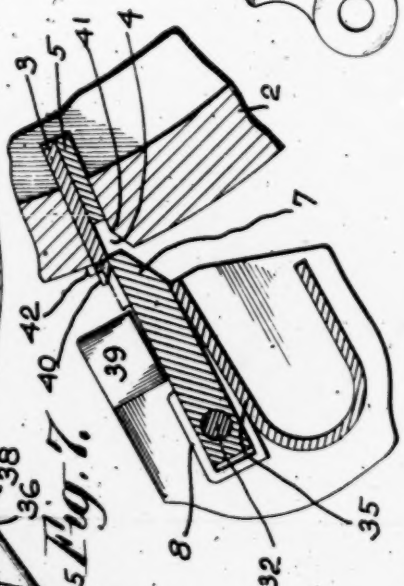

Fig. 7.

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MACHINE FOR OPERATING UPON WEB LIKE MATERIAL

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Fig. 8.

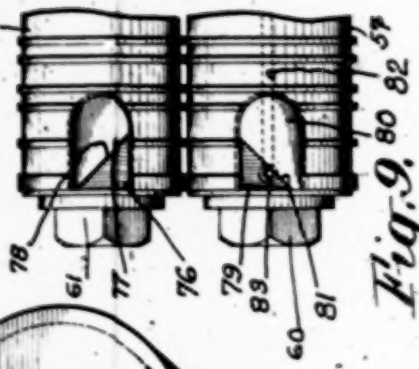
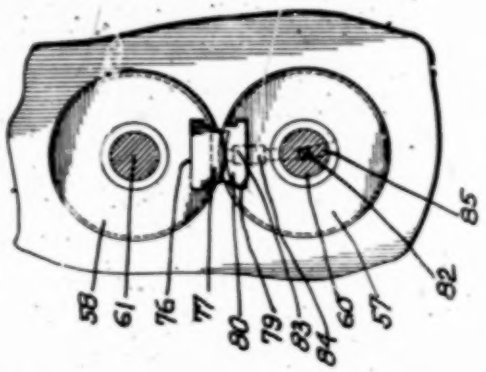


Fig. 9.



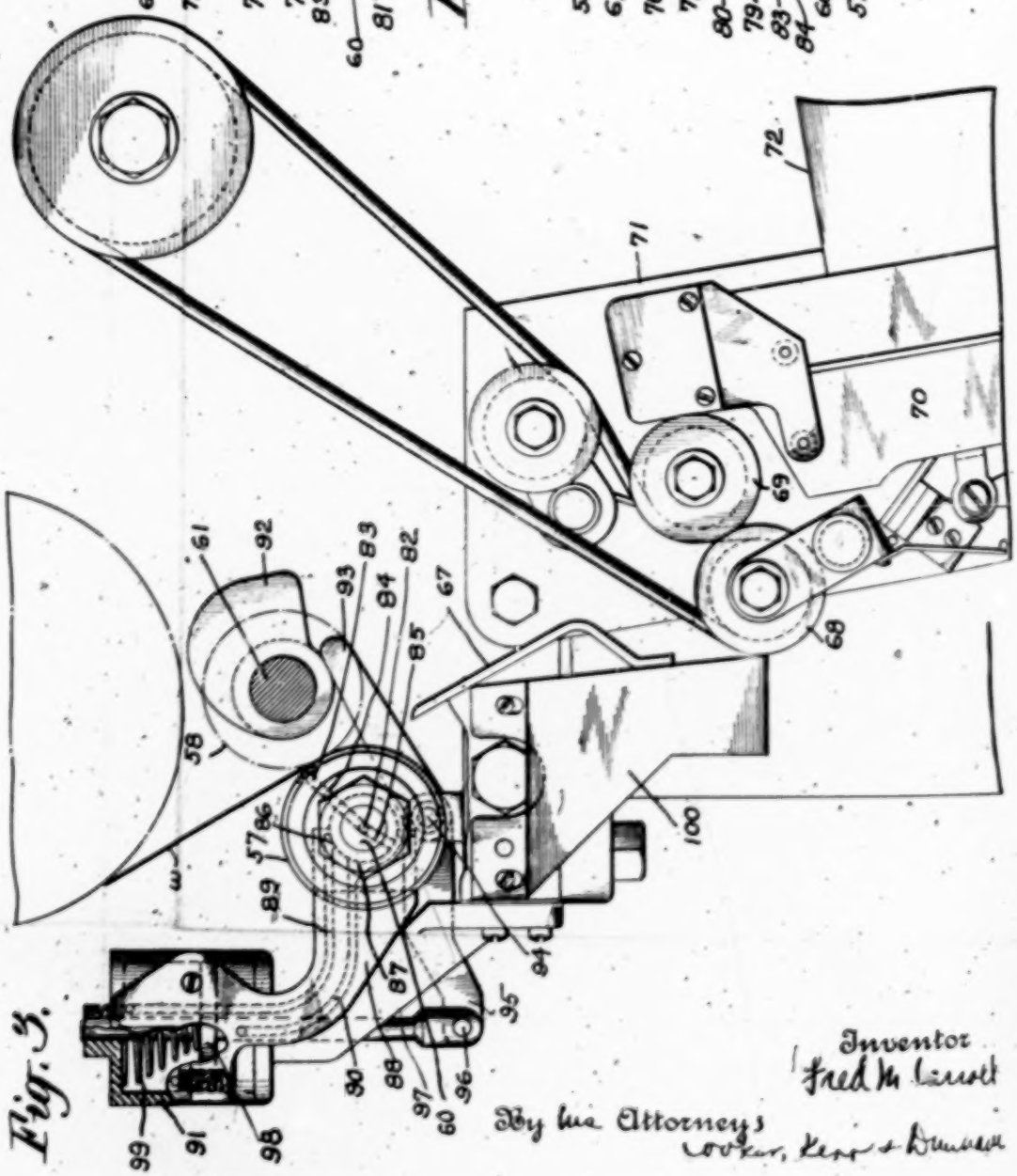


Fig. 3.

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MACHINE FOR OPERATING UPON WEB LIKE MATERIAL

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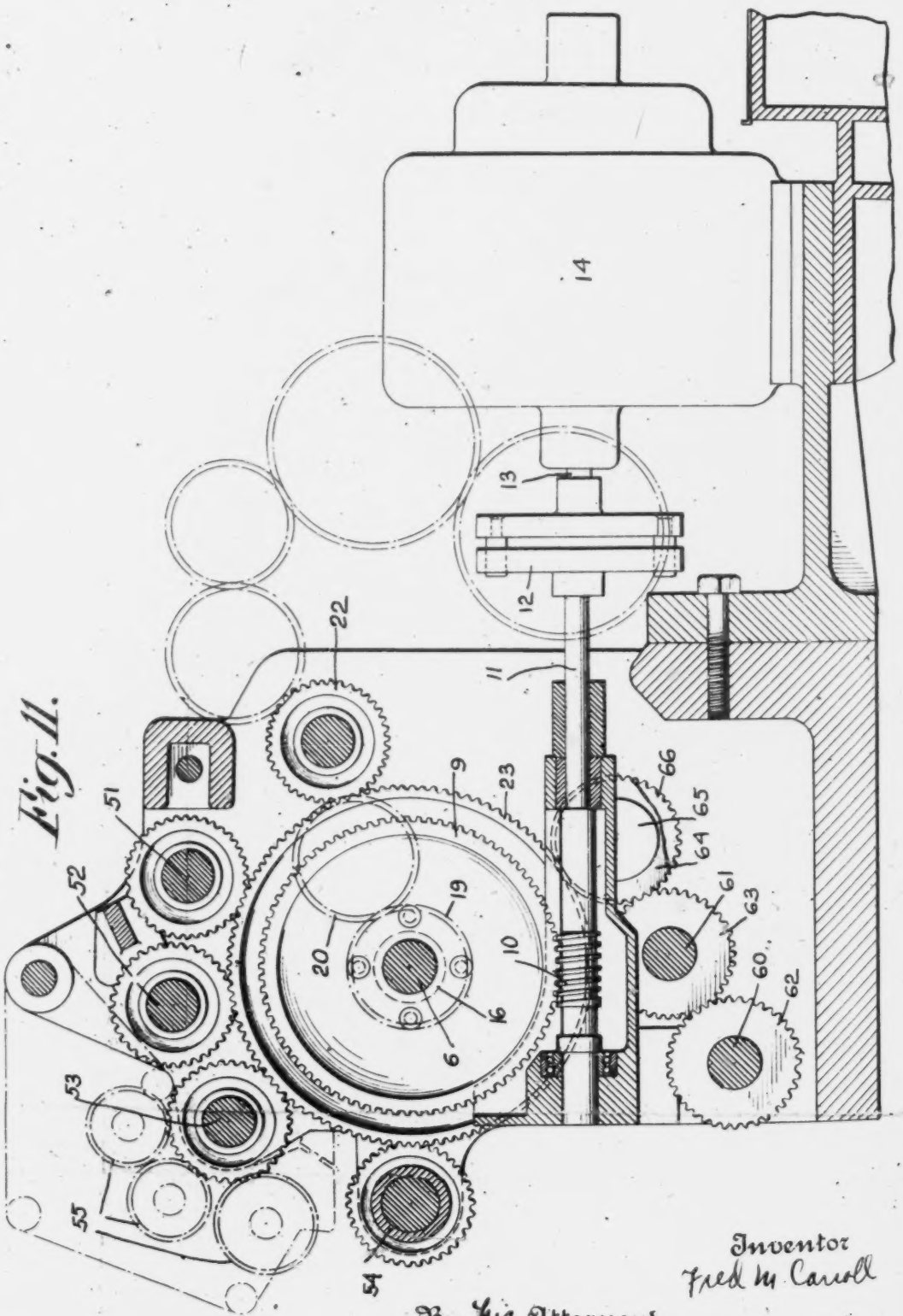

Fig. 11.

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UNITED STATES PATENT OFFICE

FRED M. CARROLL, OF YONKERS, NEW YORK

MACHINE FOR OPERATING UPON WEBLIKE MATERIAL

Application filed June 15, 1925, Serial No. 37,015, and in Germany November 24, 1922.

This invention relates to printing machines, and is in part a continuation of my application upon tabulating card printer, Serial No. 552,654, filed April 14, 1922, which has resulted in Patent No. 1,563,014, Nov. 24, 1925, and which relates to card printing machines and, from a still more specific aspect, relates to machines for printing tabulating cards, i. e., cards to be printed and employed in connection with tabulating machines of the general type illustrated in the United States Patent No. 1,087,061, February 10, 1914, H. Hollerith, and numerous other patents.

One of the principal objects of the invention set forth in my aforesaid Patent No. 1,563,014 is to provide a printing machine of increased efficiency and economy and adapted to receive blank material and to discharge accurately printed cards, of accurate size and shape.

An object of the present invention is to provide improved means for severing a continuous web of material into smaller units accurately and without interruption of the continuous feeding of the material, a provision which is of notable utility when embodied in the structure of a rotary printing machine of the type forming the subject-matter of my aforesaid application, in which certain of the features of the present application are set forth with sufficient clearness to permit their embodiment in rotary printing machines by those skilled in the art, but as these and other desirable portions of my invention are of equal utility for employment in other fields, my present application illustrates and sets them forth in somewhat greater detail, and they are hereinclaimed in this broader aspect of their more general utility.

Another object of the present application is to provide improved means adapted to receive cards and including shearing devices for severing a corner from each card, and means for holding each such severed corner upon one of said shearing devices where it is clear of the remaining card material.

Referring to the drawings which illustrate what I now consider a preferred form of machine:

Fig. 1 is a vertical sectional view of a portion of a machine of the type shown in my aforesaid application of which this application is a continuation in part.

Fig. 2 is a view in diagonal section, on an enlarged scale, taken on the line 2—2 of Fig. 1.

Fig. 3 is a fragmentary view in side elevation on a larger scale of certain of the parts illustrated in Fig. 1.

Fig. 4 is an enlarged detail sectional view of the rotary platen and severing mechanism shown in Fig. 1; Figs. 5, 6 and 7 being views in the same vertical plane as Fig. 4, showing the parts in various positions of their cycle of operation.

Fig. 8 is a fragmentary detail view of the rolls for severing a corner from the cards.

Fig. 9 is a sectional view on the line 9—9 of Fig. 10.

Fig. 10 is a longitudinal sectional view of the rotary dies shown in Fig. 8.

Fig. 11 is a vertical sectional view of the driving means for said machine.

In the illustrated embodiment, in pursuance of the invention, a platen 1 is provided having an arcuate portion 2, the periphery of which serves as the working surface on which to perform the operation of dividing a continuous web W into smaller units or cards *w*, for which purpose the platen is shown as provided with a shear member or members 3 each fixed in adjusted position within a peripheral socket 4 by means of a wedge 5.

In the rotary printing machine illustrated, the arcuate portion 2 is constituted by a rotatable cylindrical platen, and three shear members 3 are shown, spaced at equal circumferential distances, so that as this rotary platen turns upon its shaft 6, equal portions of the web W are measured off serially for severance and each such portion is severed in turn by a suitable reciprocal shear member 7, cooperating with that member of the series of platen-carried shear members 3 which is then presented in appropriate juxtaposition for the shearing operation.

In pursuance of the invention, the shear member 7 is moved into engagement with each shear member 3 successively as the latter arrives at the shearing position, to effect severance of the web, and at the same time the member 7 is given a movement of translation around the arcuate surface 2 in a curved path conforming thereto, so that the severance is accomplished without interrupting the continuous feeding of the web W forward around the arcuate surface.

In accordance with an important object of the invention, this forward feeding in regular progression is effected or facilitated by a device which provides also means 8 for engaging the web recurrently at the parts w^1 thereof which become successively the leading end after severance, and the holding means holds each such part in close juxtaposition with the platen for severance, and therafter prevents escape of the aforesaid leading end w^1 while permitting free withdrawal of the card or unit w which has been divided from the web.

The shear 7 and the holding member 8 are withdrawn successively from severing and binding action and are retracted automatically together into position for recurrent performance of the holding and severing operations upon succeeding sections of the web W, this transference of the members 7 and 8 being accomplished recurrently by any suitable means, while the forward feeding of the web W, thus cleared, continues, under operation of feeding d[illegible]e preferred form of which will be de[illegible]abed briefly hereinafter, inasmuch as a more detailed description thereof will be found upon reference to my aforesaid Patent No. 1,563,014.

When the severing mechanism is embodied in a rotary printing machine of the type illustrated, or in machines of like character, the operating parts are desirably organized in conjunction with the shaft 6 of the rotary platen, which is shown in Fig. 11 as having a worm-gear 9 in mesh with a worm 10 on a shaft 11 coupled at 12 to the shaft 13 of an electric motor 14, by which the platen is rotated continuously in the direction of the arrow X, Fig. 4.

Also mounted on the shaft 6 is a sleeve 16 having eccentrics 17 and 18 fast thereon, and a gear 19 forming part of a chain of gears 19, 20, 21, 22 and 23, actuated by the shaft 6; and upon the eccentrics are straps 24 formed as part of a frame 25 which has one lever arm forked at 26 to receive a block 27 on a stud 28 mounted on the frame part 29, while another arm 30 serves as the support for the reciprocal shear member 7 and the holding member 8 with their associated parts.

The shear member 7 comprises a long flat blade having end sockets 31 to receive pins 32 seated against springs 33 in bearings 34 formed on the arm 30, brackets 37 and 38. By withdrawing the pins 32 the shear 7 may be taken out or replaced. It is normally held in its uppermost position (see Figs. 4–7) by the U-shaped spring 35 secured by screws at 36 to the bracket 37 of the lever arm 30; and this bracket and the similar bracket 38 at the other end of arm 30 are provided with stops 39 to limit the upward swing of the shear 7, and the shear slots 4 in platen 1 have beveled walls 41 to aid in securing firm shearing contact between the shear 7 and shears 3.

The holding member 8 preferably takes the form of a U-shaped clip embracing the shear member 7 and sharing its rocking movements around the pivots 32, but capable of independent sliding movement, having a forward abutment portion 42 adapted to be held toward the arcuate surface 2 of the platen 1 in position to bind the web W directly adjacent to the shear 3, this binding engagement being of a yielding character, under the action of a leaf spring 43 seated at 44 on the brackets 37 and 38 (see Fig. 2).

For the sake of clearness, the web does not appear in Figs. 2, 4, 5, 6, and 7, but is shown clearly in Fig. 1, which illustrates the parts at the completion of a severing operation with the rotary platen 1 running forward continuously. The web W is derived from any suitable source, such as the roll shown in my Patent No. 1,563,014, and is drawn around a leading roll 45 by the action of feed rolls 46 and 47, passing thence through suitable straightening devices 48, 49 and a guide 50 to the rotary platen 1, around the periphery 2 of which the web is guided and drawn by rolls 51, 52 and 53, which are geared to the shaft 6 as shown in Fig. 11.

The feed rolls 46 and 47 preferably deliver the web at a linear speed somewhat in excess of the peripheral speed of the rotary platen, the rolls being spaced to permit slip in feeding, so as to avoid over-running, and the machine illustrated is provided with a printing roll 54 and suitable inking mechanism 55, which need not be described in detail, except to note that the printing roll preferably cooperates with the platen at a region not far from the point of severance.

In operation, as the shaft 6 is rotated by the motor 14 the platen 1 is turned and the eccentrics 17 and 18, cooperating with the block 27 in the fork 26, cause the frame 25 to oscillate in an elliptical path which is indicated in dotted lines in Fig. 5.

In Fig. 4 the parts are shown in detail in the severing position shown in Fig. 1, with the shear 7 at its extreme inward position and the holding member 8 likewise at the inner position of its orbit, having its abutment 42 pressed toward the platen surface 2 in position to bind the leading end of the web (not shown). When the eccentrics 17 and 18 have turned into the position indicated in Fig. 5, the shear 7 has been withdrawn from engage-

ment with the severed end of the web or card, and the abutment 42 of the holding member 8 still binds to the platen the leading end of the fresh unsevered portion of web which is now being printed by the printing roller 54.

At this phase occurs the delivery of the severed card or unit *w* to the mechanism shown in Fig. 3, which embodies the portion of this invention relating to the clipping of a corner from the severed card, an operation which will be described duly, after completing the description of the cycle of movement of the movable shear 7 and the holding means 8.

In Fig. 7 the position of the parts is approximately the same as in Fig. 5, but a portion of the holding member 8 is broken away to show the manner in which the shear 7 tilts as the shear 3 continues its movement downward with the platen part 2. By this provision, which the spring 35 permits, any injury of the shear 7 by shear 3 is avoided, and in Fig. 6 the shear 7 is shown as about to come clear of the finger 40 of shear 3, the cutting edge of shear 7 having already left the cutting edge of shear 3, and the holder 8 having likewise been carried back by the movement of arm 25 under the action of eccentrics 17 and 18, so that when the arm 25 starts to move upward in its orbit in the direction of the arrow in Fig. 5 there will be no interference with the leading end of the severed web, which will run down between the shears ready for the holder abutment 42 to enter into binding engagement with it when the arm 25 has passed the upper extreme of its orbit and is drawn in toward the platen 2 by action of the eccentrics 17 and 18, repeating the phases of the cycle, in cooperation with the next member 3 of the series of platen-carried shear members, and without interruption in the forward movement of the web W.

Having thus described the preferred structure of severing mechanism and its operation, it is to be understood that the same may be utilized in any field for which the improvements are adapted by their nature, and the cards or other units severed from the web may be delivered in any suitable manner for use or for further treatment, as for example for severance by the improved corner-clipping mechanism now to be described.

Before any card has been severed from the remainder of the material its leading edge will have passed preferably between rollers 57 and 58, being gripped thereby. For reasons hereinafter stated these rollers are preferably so driven and so timed that they will present the same points on their peripheries to any card entering between them as they do to any other card so entering but their linear peripheral speeds are slightly in excess of that of the drum 1. It will be seen that these two requirements are not inconsistent and are readily obtainable, the first being a function of angular velocities and the second a function of angular velocities of rolls 57 and 58 and the radii of the latter. I shall now proceed to describe the driving means for the rollers 57 and 58, having specific recourse to Figs. 1 and 8 to 11 for this purpose.

The rollers 57 and 58 are each secured to a corresponding one of the shafts 60, 61, suitably journaled in the frame of the machine. Each of the shafts 60, 61 has secured thereto a corresponding one of identical gears 62 and 63 which mesh with each other. The gear 63 meshes also with a suitably journaled idler gear 64 on a shaft 65 which has a gear 66 which in turn meshes with and is driven by the gear 23. The rollers 57 and 58 are preferably provided with card-corner-clipping devices. Before proceeding to describe these devices, I shall describe the means for conveying the cards to the receptacle or tray 71.

By inspecting Figs. 1 and 3 it will be seen that the cards pass from the rollers 57, 58 over a plate 67, suitably secured to the frame of the machine, and thence between rolls 68 and 69 into suitable stacking mechanism 70 and a tray 71, secured to and carried by the bracket 72.

As mentioned above, the rollers 57 and 58 are preferably provided with devices for clipping the corners of the cards or card material. One form of such device is illustrated in Figs. 3, 8, 9, and 10 in detail. The roller 58 is there shown provided with an insert 76 of steel or other suitable material and having a raised portion 77 providing a diagonal cutting edge 78. The roller 57 is provided with an insert 79 having a raised portion 80 and diagonal cutting edge 81 which are complementary to the elements 77, 78. The design is such that one of the two trailing corners of each card, entering between the rollers 57, 58, is clipped or sheared off by the cooperating cutting edges 78—81. In order to insure that these clippings will not be thrown to such position as to injure the machine or the cards, I preferably provide means for holding each such clipping to one of the rollers 57, 58 until it is in proper position to be discharged therefrom. While the clippings when released from the said roller may be allowed to drop by gravity, in certain cases gravity alone may not prove effective. For example, static or frictional electricity may at times cause the clippings to adhere to the rolls. I therefore propose not only to provide means for holding each clipping to the roller until the discharge position is reached, but also means for positively forcing each clipping away from the roller when the discharge position is reached. A now preferred form of such means is il-

lustrated and may be constructed substantially as follows. The shaft of one of the rollers 57, 58, in the present case the shaft 60 of the roller 57, is provided with a duct 82 which communicates at one end with a port 83, in the insert 79, through the port 84 provided in the roller 57. The other end of the duct or passage 82 terminates in a radial branch 85 (see Fig. 3). The latter is adapted to cooperate with the ports 86 and 87 provided in a member 88 partially surrounding the shaft 60 and forming therewith a valve as clearly indicated in Fig. 3. The member 88 is provided with ducts or passages 89, 90, leading from the ports 86, 87 to upper and lower ends respectively of a cylinder 91 of a pump which is suitably secured to the frame of the machine. It will be seen that when the parts are in the position shown in Fig. 3, and indeed as long as the port 85 registers with the port 87, communication is established between the port 83 and the lower part of the cylinder 91. At this time the insert 79 moves from the position shown in Fig. 3 to a position below the axis of the roller 57. When the insert 79 and its port 83 are substantially directly below the axis of the roller 57, communication between the lower part of the cylinder 91 and the said port 83 is cut off, and communication between the upper end of the cylinder and the port 83 is established through the following passages; 89—86—85—82—84—83. Mechanism is provided for automatically causing the pump to create a suction or negative pressure at the port 83 when the ports 85—87 are in communication and for providing a positive pressure at the port 83 when the passages 85—86 communicate. I shall now proceed to describe the particular form of such mechanism illustrated in the drawings.

The shaft 61 has secured thereto a cam 92 adapted to engage and operate the arm 93 of a bell-crank lever pivoted at 94 on the frame of the machine. The other arm 95 of the bell-crank is connected at 96, by a suitable pivotal connection with the piston rod 97 of the pump. The rod 97 is provided with a shoulder portion (Fig. 3) adapted to engage the lower side of and move the piston 98 upwardly in the cylinder 91. A compression spring 99 biases the piston and connected parts toward the opposite position. The parts are preferably so timed that when the ports 85—87 are in communication the piston 98 is moving upwardly and creating a suction or negative pressure in the lower part of the cylinder and consequently at the port 83. This suction holds the clipping to the roller 57. Communication is established between the ports 85—86 before the piston is permitted to move downwardly. Bearing in mind that upward movement of the piston 98 compresses air in the upper part of the pump cylinder it will be appreciated that when the ports 85—86 communicate a blast of compressed air is discharged through the port 83, thus positively impelling the clipping downwardly away from the roller 17 and into a suitable chute or receptacle 100. The above described cycle is repeated as each clipping of the corner of a card is effected.

What I claim is:—

1. A machine for severing a continuous web or sheet of material into similar units, comprising in combination a rotary platen, means for causing material to travel around and in contact with said platen, means for preventing slip of the material with respect to said platen prior to shearing, a knife blade directed towards the platen, and means for moving said blade towards and into cooperative shearing relation with the platen while advancing the blade peripherally of the platen and for withdrawing said blade from the platen after the shearing operation while moving the blade peripherally of the platen and for returning the blade to its initial position in the cycle while maintaining the blade constantly directed towards the platen.

2. A machine for severing a continuous web or sheet of material into smaller units, comprising in combination, a rotatable platen, means for supplying material to said platen, means for continuously rotating said platen, means for cutting said material into card lengths before it leaves said platen, said last named means comprising a knife and means for reciprocating said knife towards and away from said platen and for moving said knife alternately in the same and in an opposite direction to the movement of said web transversely of the line connecting its extremes of reciprocatory movement toward and away from the platen.

3. A machine for severing a continuous web or sheet of material into smaller units comprising, in combination, a rotary platen, means for supplying material thereto, means for cutting said material into card lengths, said last mentioned means comprising a shearing couple of which one element is carried by said platen and the other element of which is movable toward and away from the first named element, and means comprising a cam lug carried by said platen for engagement with said second named element to guide the same between the cam lug and first-named element into shearing position with respect to said first named element.

4. A machine comprising a rotary platen carrying a web of material, a plurality of shearing elements carried by the platen, a single knife cooperating with each of the shearing elements in turn at a shearing position for shearing the material into lengths, means for guiding the knife into shearing relation with each succeeding shearing element, and means for clamping the material

during shearing at a point adjacent the shearing position.

5. In a machine for severing a continuous web or sheet of material into smaller units, said machine being provided with a rotary platen, means for applying the web of material to said platen and for guiding the web partially around the same, severing means positioned exteriorly of the platen, and means for oscillating the severing means adjacent the periphery of the platen and to reciprocate it to and from said periphery while constantly maintaining the cutting edge of the severing means directed towards the platen.

6. In a machine for severing a continuous web or sheet of material into smaller units, said machine being characterized by a rotary platen, means for supplying a web of material to said platen, a plurality of knife elements carried by said platen, movable knife means mounted independently of said platen and adapted for cooperation with the aforesaid knife elements on the said platen, and means for imparting a movement of translation to the movable knife means substantially in the same direction as the direction of the movement of said platen at the time of cutting engagement whereby cutting may be effected of the material intervening between the platen carrying knife elements and the movable knife means while the latter are both moving at substantially the same velocity.

7. In a machine for severing a continuous web or sheet of material into smaller units, said machine being characterized by a platen having an arcuate surface and by means for delivering said web continuously around the periphery of said platen, the combination therewith of means acting recurrently to sever said web at a predetermined point in its travel around said arcuate surface, means arranged to accompany said web around a portion of said platen in a coaxial arcuate path, engaging said web recurrently at the parts thereof which become successively the leading end after severance and holding each such part in close juxtaposition with said platen for severance, and means to actuate said holding means for said holding operation and to retract the same from holding engagement with the web and move said holding means in a direction opposite to the movement of said platen to the appropriate region to initiate each such holding operation.

8. In a machine for severing a continuous web or sheet of material into smaller units, said machine being characterized by a rotary platen and means for rotating the same, the combination of means for feeding a continuous web of material around the periphery of said platen, means associated peripherally with said platen for severing said web periodically at intervals measured by the peripheral arc subtended by a given radius of said platen in traveling through a predetermined number of degrees, holding means adapted to move peripherally in contact with said web during each such period of severance, acting to hold the web at the time of severance, and means to withdraw said holding means from such contact and move the same counter to the direction of travel of said web for engagement with an unsevered portion of the same.

9. In a machine for severing a continuous web or sheet of material into smaller units, said machine being characterized by a platen having an arcuate surface and by means for delivering said web continuously around the periphery of said platen, the combination therewith of a device including severing means and holding means arranged to accompany said web around a portion of said platen in a coaxial arcuate path, said severing means acting recurrently to sever said web at a predetermined point in its travel around said arcuate surface and said holding means engaging said web recurrently at the parts thereof which become successively the leading end after severance and holding each such part in close juxtaposition with said platen for severance, and means acting alternately to actuate said device for said holding and severing operations and to move the same counter to the direction of travel of said platen to the appropriate region to initiate successive holding and severing operations.

10. In a machine for severing a continuous web or sheet of material into smaller units, said machine being characterized by a platen having an arcuate surface and by means for delivering said web continuously around the periphery of said platen, the combination therewith of a lever mounted to oscillate concentrically relatively to said arcuate surface, and adapted to reciprocate relatively thereto, having a shear member acting recurrently to sever said web at a predetermined point in its travel around said arcuate surface, said lever being arranged to move said shear member to accompany said web around a portion of said platen in a coaxial arcuate path, and having holding means for engaging said web recurrently at the parts thereof which become successively the leading end after severance, holding each such part in close juxtaposition with said platen for severance, and means to actuate said lever and its shear member and holding means for said holding operations and severing operations, and to retract the same from holding and severing engagement with said web and to return said lever to the appropriate region to initiate successive severing and holding operations.

11. In a machine for severing a continuous

web or sheet of material into smaller units, said machine being characterized by a rotary platen provided with a series of peripheral shear members, and means for rotating said platen, the combination of means for feeding a continuous web of material around the periphery of said platen, means associated peripherally with said platen for severing said web periodically at intervals measured by the peripheral distance between said platen and said shear members, said severing means acting successively in conjunction with said platen carried shears and being adapted to move peripherally with said web during each such period of severance, means associated with said shearing means to engage and hold the web at the time of severance, and means to withdraw said holding and severing means from such contact and move the same counter to the direction of travel of said web for successive engagement with unsevered portions of the same.

12. In combination with a rotary platen and means for supplying a web of material thereto, a device reciprocating in a direction angular to the axis of said platen and having means to treat the material carried by the platen during the continuous forward rotation thereof, said reciprocating device being adapted to act upon the web at one region thereof while moving synchronously therewith, and after acting on said web to move in a direction counter to the movement of the platen to act on the web at another region thereof.

13. In combination, a rotary shearing member, an elongated shearing member having a cutting device at its forward end, means for supporting the elongated member at the opposite end, and means for moving said member through a shearing cycle comprising a movement from an initial position towards the rotary member to effect shearing cooperation between the cutting device and rotary member, a movement of the elongated member in the direction of the rotary member during shearing, and a movement of the elongated shearing member away from the rotary member and back to initial position, said elongated member being constantly maintained during said shearing cycle with its forward end directed towards the rotary member.

14. The combination in a web-severing mechanism, of a platen having an arcuate surface with a shear member mounted therein and a reciprocable shear member mounted on an oscillatable support independent of said platen adjacent to said surface to cooperate with said platen shear member.

15. The combination in a web-severing mechanism of a rotary platen provided with an arcuate surface adapted to support a continuously moving web for treatment, and having a shear-member mounted therein, and a reciprocable shear-member mounted on a support arranged to oscillate relative to said arcuate surface and to move toward and away from said web, whereby said shear-members are brought into cooperative relation recurrently to sever successive portions from said web, moving therewith during each severing operation and moving counterwise between the severing operations.

16. In a web-severing machine having cooperating shear members one of which is reciprocable and a support for said reciprocable shear member the combination with said reciprocable shear-member of a holding device having an abutment portion adapted to engage and hold the web at times and having a flange to embrace said reciprocable shear member loosely, and a spring between said holding member and support tending to maintain said holding engagement while permitting reciprocation of said shear member.

17. In a web-severing machine having cooperating shear members one of which is reciprocable and a support for said reciprocable shear member the combination with said reciprocable shear-member of a holding device having an abutment portion adapted to engage and hold the web at times and having a flange to embrace said reciprocable shear member loosely, and a spring between said holding member and support tending to maintain said holding engagement while permitting reciprocation of said shear member, said reciprocable shear-member and holding member being arranged to move pivotally upon said support to accommodate the peripheral movement of said platen-carried shear.

18. In a web-treating machine having cooperating shear-members as set forth in claim 17-a support for the reciprocable shear member provided with means to permit pivotal movement of said shear-member upon said support and relatively to said platen-carried shear-member during their engagement, and means to maintain said engagement yieldingly and to permit ready removal of said reciprocable shear from said support, said means comprising one or more spring-pressed pivot pins carried by said support and arranged to enter sockets in said reciprocable shear, a separately formed leaf spring carried by said support and tending to rotate said shear about its pivotal axis, and a stop or stops carried by said support to limit said rotative movement of said shear, said pivots and spring constituting a unitary structure with said support from which said reciprocable shear is removable freely.

19. A web-severing machine having cooperating platen-carried and reciprocable shear-members as set forth in claim 15, said platen-carried shear-member having a projection with an inclined face to engage and position said reciprocable shear member prior to shearing action, and said reciprocable shear mem-

ber having an inclined portion to engage a portion of the platen structure to cause close shearing engagement of said shear members with each action.

20. Shearing mechanism comprising coacting shearing members, a support for each member, one of said members being swingable on its support, said swingable shear member reciprocating relatively to the other, and a holding device for the material to be severed, said device comprising a holding member mounted adjacent to said reciprocating shear member and adapted to engage and hold said material independently of its engagement by said shear member.

21. Shearing mechanism comprising coacting shearing members, a carrier for each member, a support on which one of said carriers is reciprocated, relative to the other carrier, said other carrier moving relatively to said support, and a holding device for the material to be severed, said device comprising a holding member carried by said reciprocating carrier and adapted to engage and hold said material independently of its engagement by the shear member carried by said reciprocating carrier.

22. In a web-severing machine a rotatable shaft, a cylindrical platen carried thereby and provided with a shear member, a frame journaled upon said shaft and adapted to oscillate thereupon, and eccentrics geared to said shaft and connected with said frame to cause oscillating movements thereof co-ordinated with the rotation of said platen; said frame having arms provided with opposed spring-pressed centers, a reciprocal shear-member mounted pivotally between said centers, a spring carried by said frame and tending to rotate said shear about said centers, means on said frame to limit said rotation of said shear, a U-shaped holding member embracing said shear and supported loosely thereby, having an abutment portion to engage the web, and a spring mounted between said arms in engagement with said U-shaped member tending to move the same normally into engagement with said web, independently of the movement of said shear, said shear and U-shaped member and their associated parts constituting with said frame a unitary structure movable toward and away from said platen, and oscillating to and fro about the periphery thereof, when said shaft is rotated, to effect recurrent shearing action upon said web with synchronous movements of said shears peripherally therewith, and alternating retractive movements of said frame structure.

23. In a web-severing machine a rotatable shaft, a cylindrical platen carried thereby and provided with a shear member, a frame journaled upon said shaft and adapted to oscillate thereupon, and eccentrics geared to said shaft and connected with said frame to cause oscillating movements thereof coordinated with the rotation of said platen; said frame having arms provided with opposed spring-pressed centers, a reciprocal shear-member mounted pivotally between said centers, a spring carried by said frame and tending to rotate said shear about said centers, means on said frame to limit said rotation of said shear, a U-shaped holding member embracing said shear and supported loosely thereby, having an abutment portion to engage the web, and a spring mounted between said arms in engagement with said U-shaped member tending to move the same normally into engagement with said web, independently of the movement of said shear, said shear and U-shaped member and their associated parts constituting with said frame a unitary structure movable toward and away from said platen, and oscillating to and fro about the periphery thereof, when said shaft is rotated, to effect recurrent shearing action upon said web with synchronous movements of said shears peripherally therewith, and alternating retractive movements of said frame structure, said U-shaped member and reciprocal shear member being removable from said frame while the latter remains in place.

24. In combination, a member having a cyclical movement and adapted to support a web of material, a device provided with a cutter at the forward end, means for moving said device to and from said member several times during one cycle of movement of said member to effect a plurality of shearing operations on the web by said cutter, and means for mounting and guiding said device during the several shearing operations and during the period between said operations with its forward end constantly directed towards said member.

In testimony whereof I hereto affix my signature.

FRED. M. CARROLL.

No. 677,214. Patented June 25, 1901.

H. HOLLERITH.

TABULATING APPARATUS.

(Application filed July 17, 1900.)

(No Model.) 10 Sheets—Sheet 1.

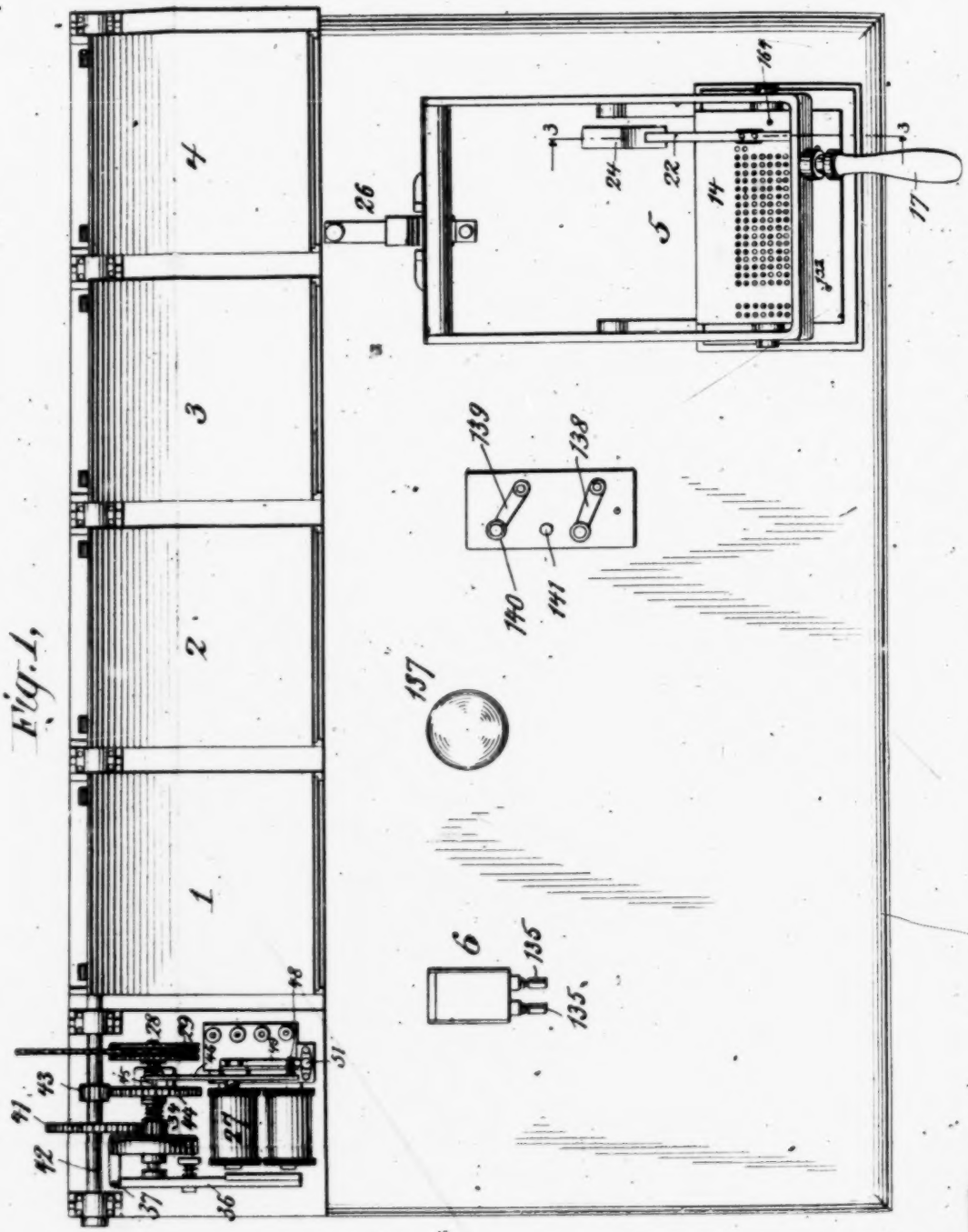

Fig. 1.

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(Application filed July 17, 1900.)

(No Model.) 10 Sheets—Sheet 2.

Fig. 2,

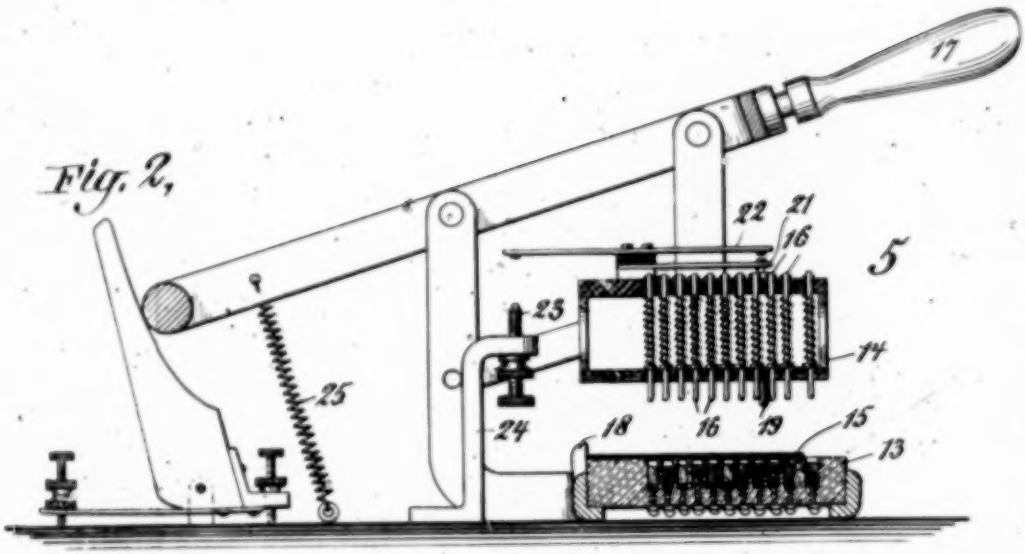


Fig. 3,

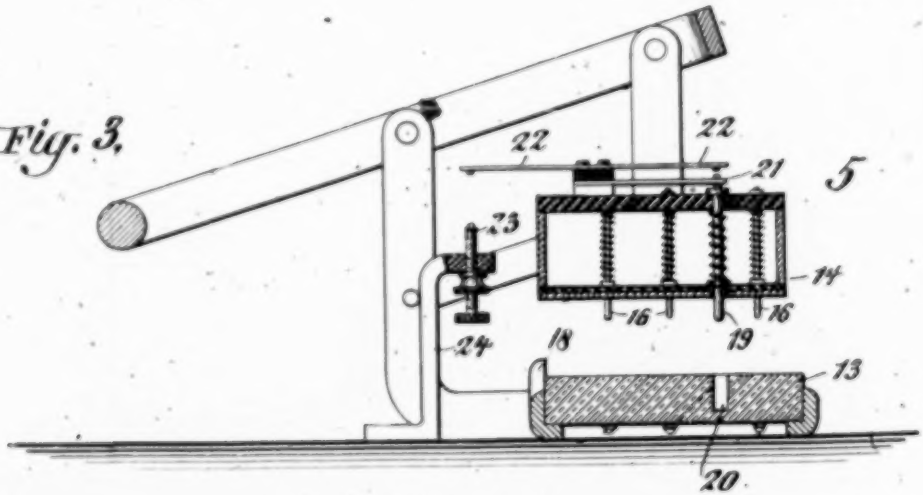
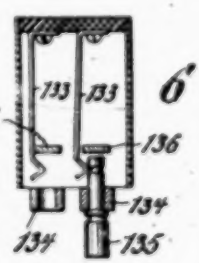


Fig. 4,



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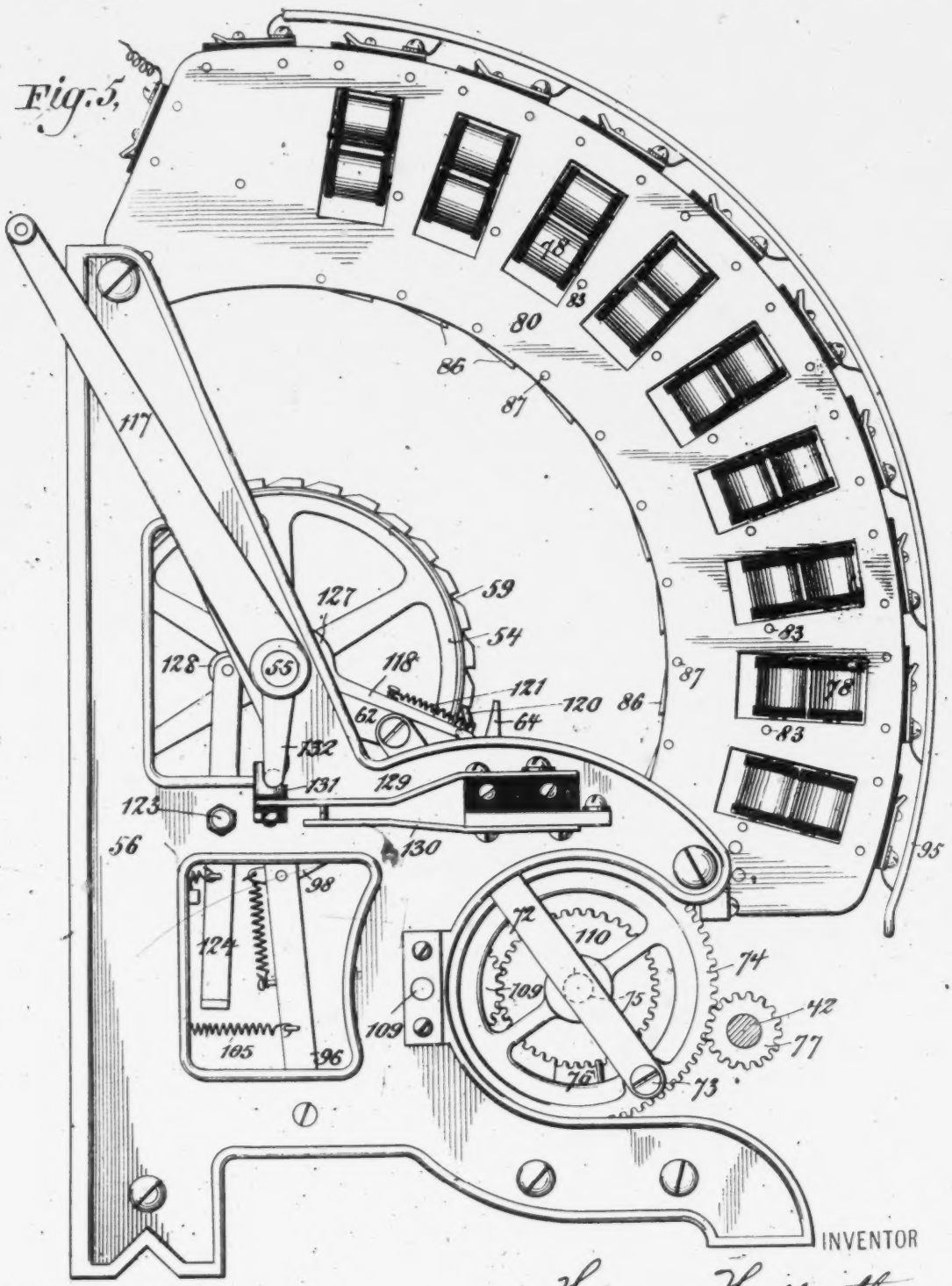
(Application filed July 17, 1900.)

(No Model.) 10 Sheets—Sheet 3.

Fig. 5.



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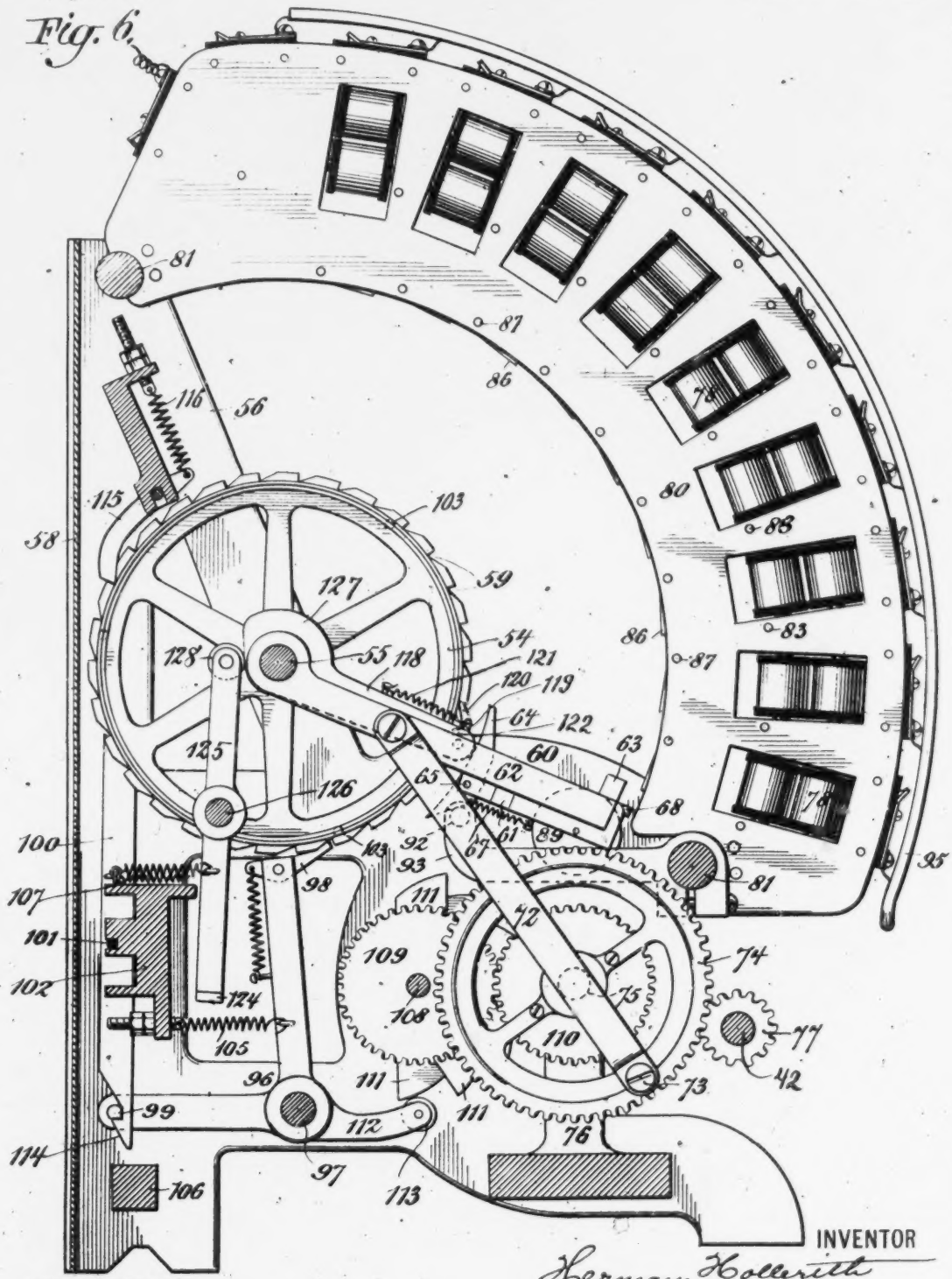
TABULATING APPARATUS.

(Application filed July 17, 1900.)

(No Model.) 10 Sheets—Sheet 4.

Fig. 6.



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No. 677,214. Patented June 25, 1901.

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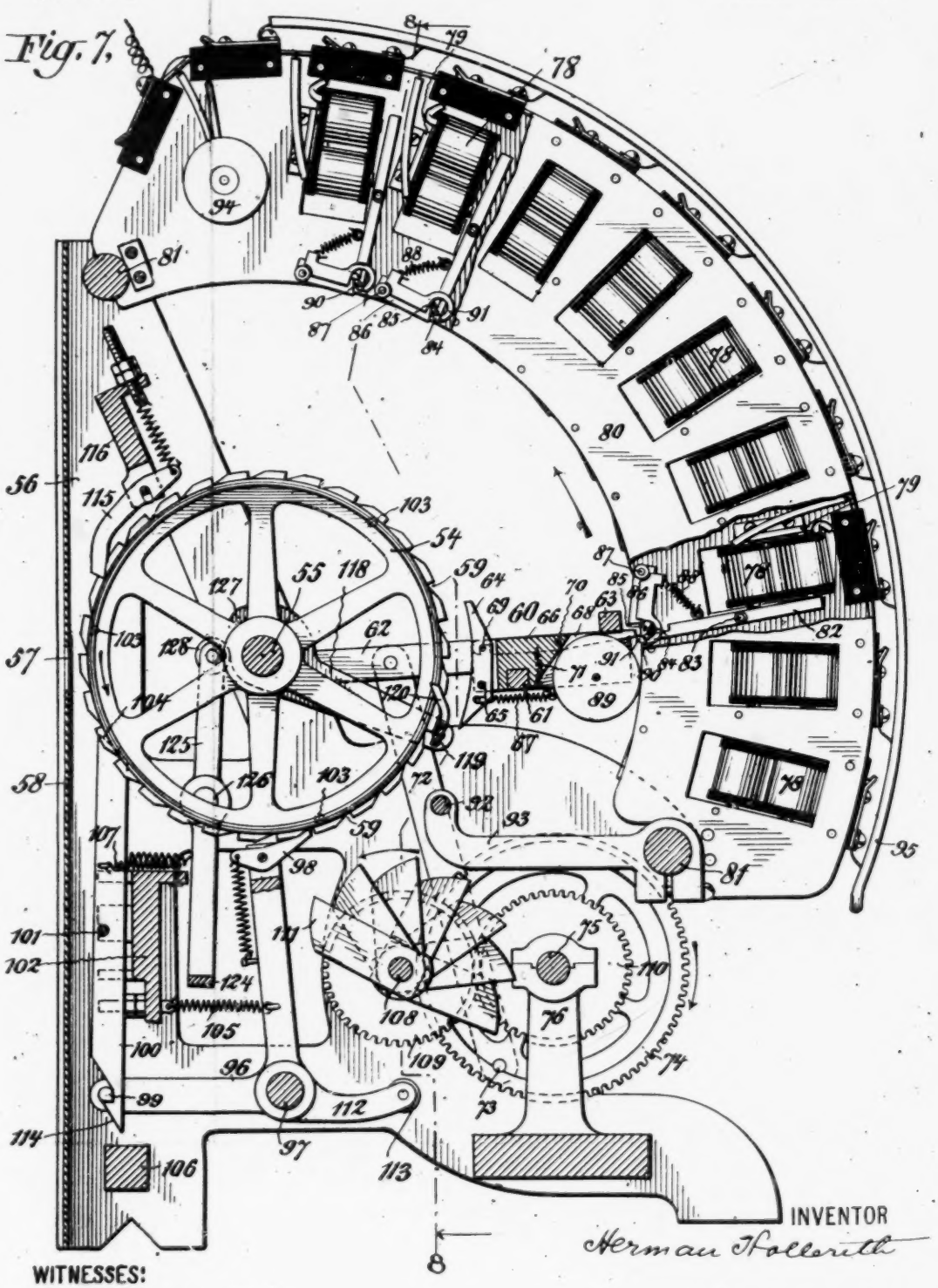
TABULATING APPARATUS.

(Application filed July 17, 1900.)

(No Model.) 10 Sheets—Sheet 5.

Fig. 7.



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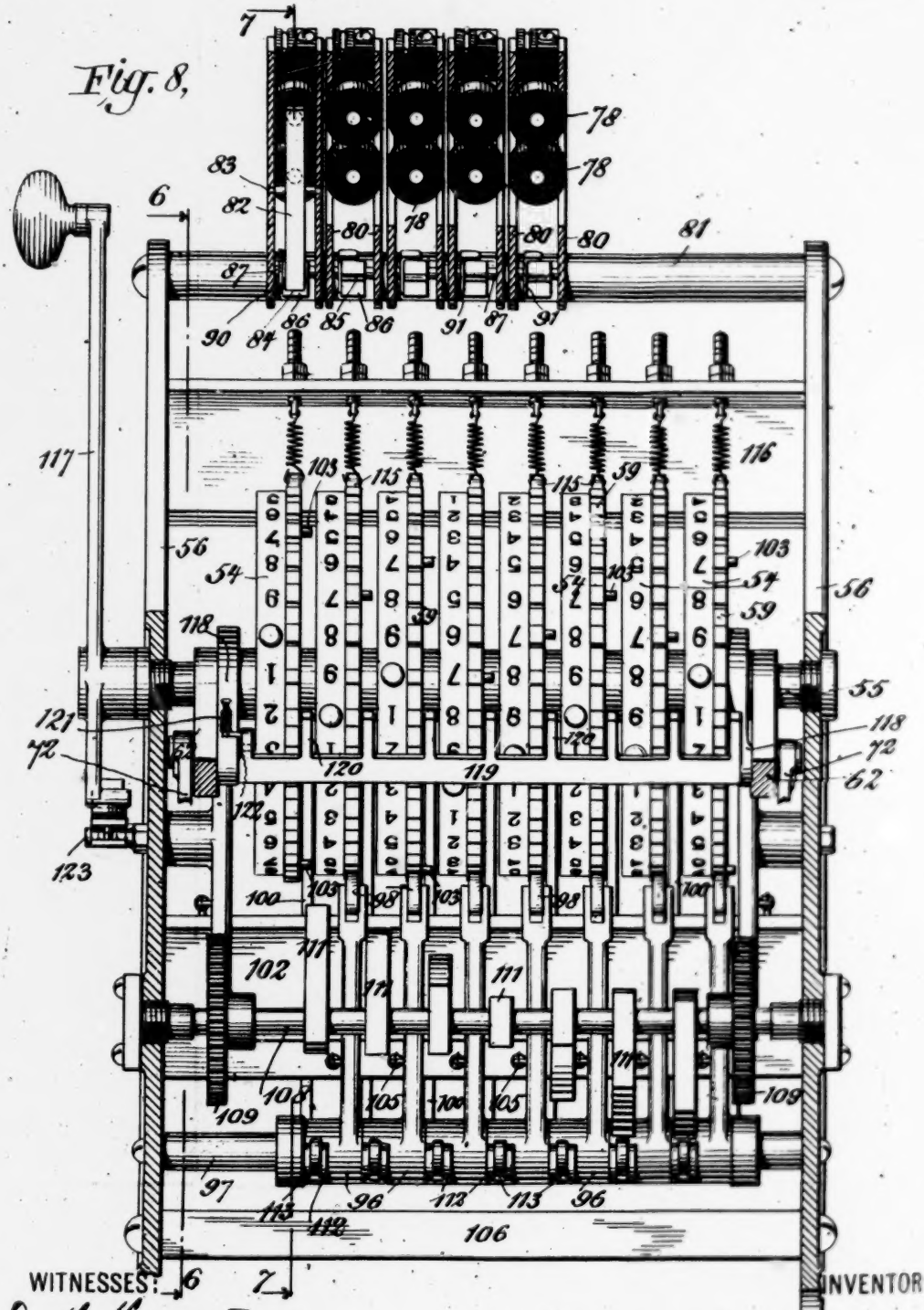
(No Model.) 10 Sheets—Sheet 6.

Fig. 8.



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(No Model.) 10 Sheets—Sheet 7.

Fig. 9.

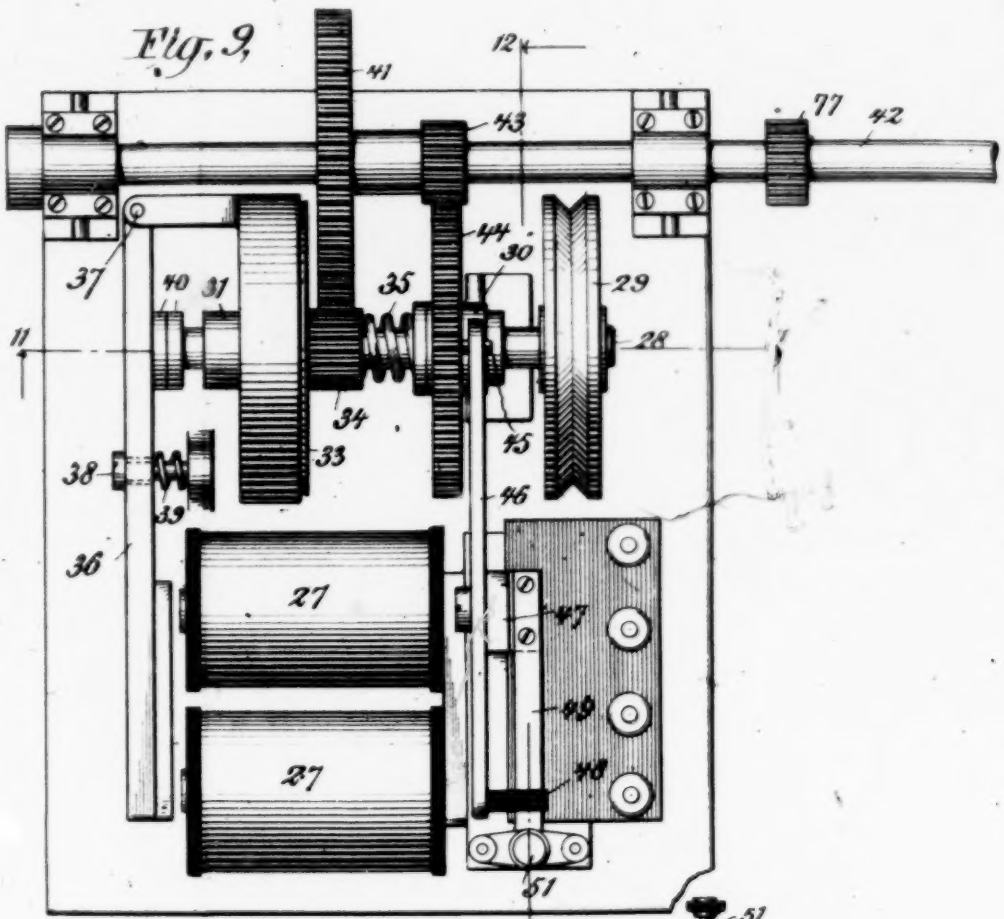
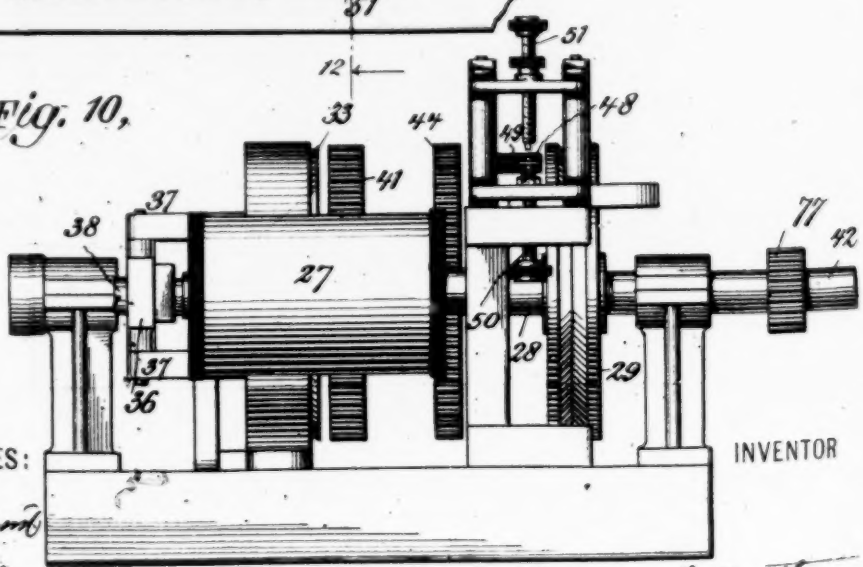


Fig. 10.



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(Application filed July 17, 1900.)

(No Model.) 10 Sheets—Sheet 8.

Fig. 11.

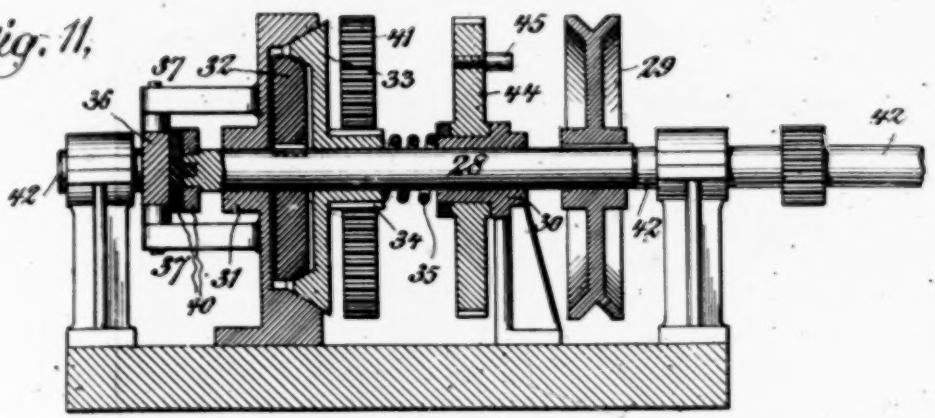
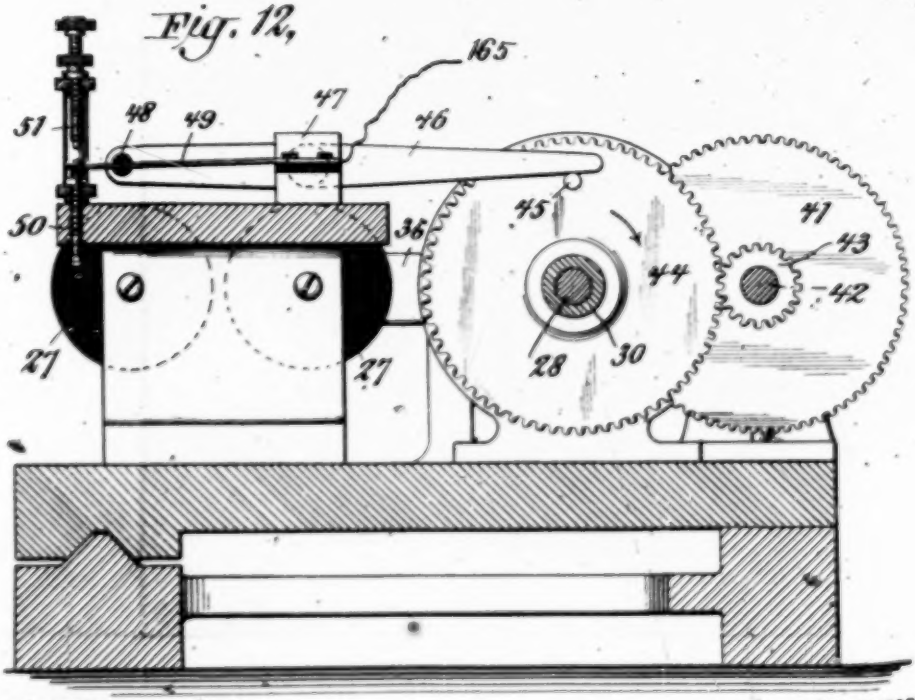


Fig. 12.



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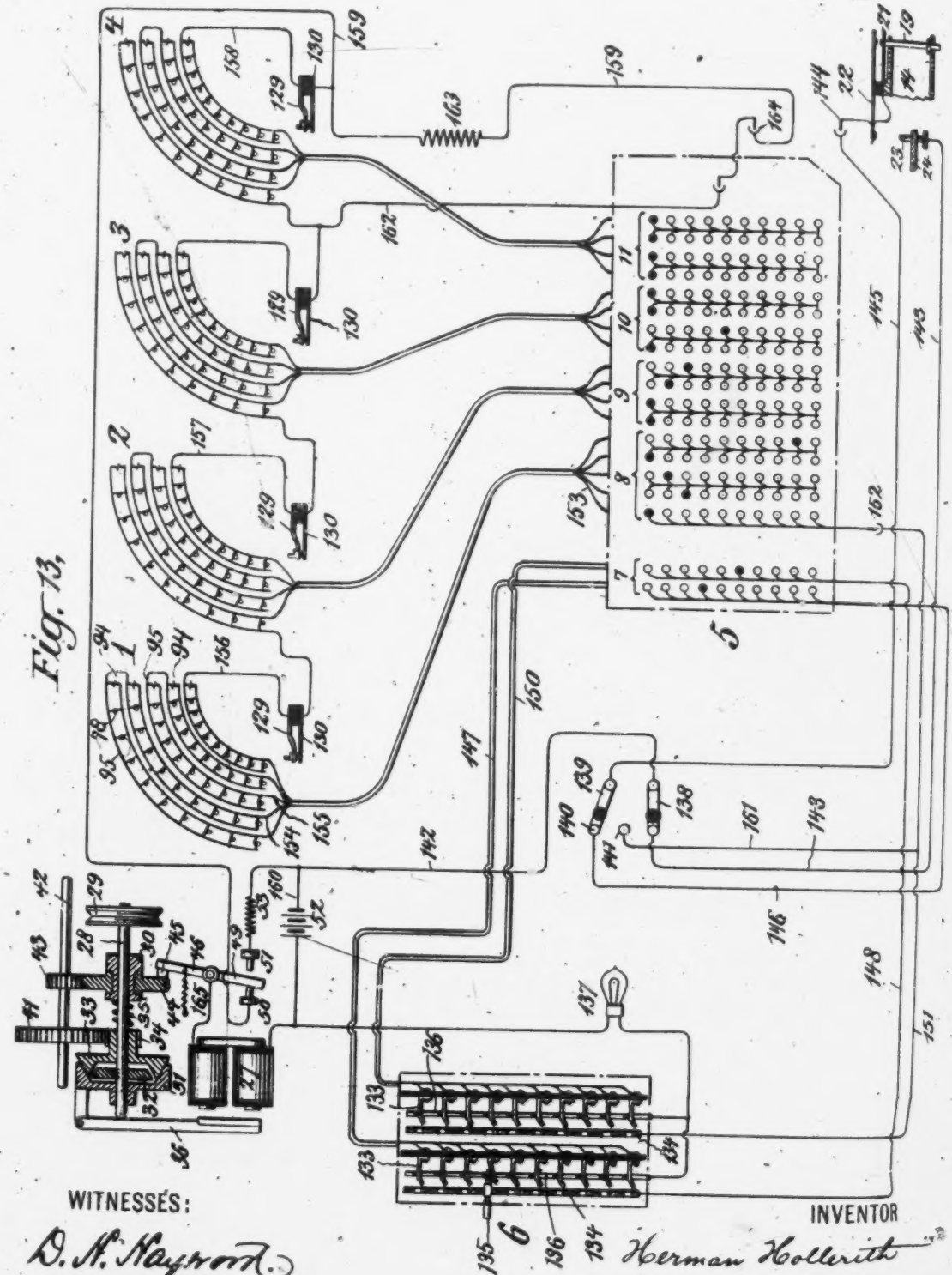
(Application filed July 17, 1900.)

(No Model.) 10 Sheets—Sheet 9.

Fig. 13.



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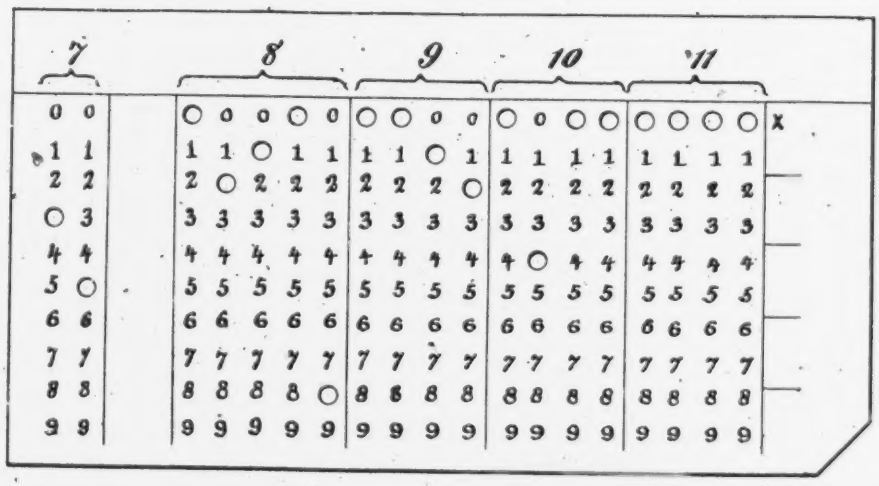
(Application filed July 17, 1900.)

(No Model.) 10 Sheets—Sheet 10.

Fig. 14.



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TABULATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 677,214, dated June 25, 1901.

Application filed July 17, 1900. Serial No. 24,019. (No model.)

To all whom it may concern:

Be it known that I, HERMAN HOLLERITH, a citizen of the United States, and a resident of Garrett Park, Montgomery county, Maryland, have invented certain new and useful Improvements in Tabulating Apparatus, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification.

My invention relates to improvements in means and apparatus for tabulating data, such as statistical items which have been designated in or upon a suitable record.

For the purpose of simplicity and clearness of description, but without intending to thereby place any limitation or restriction upon my invention, I will in describing it refer to apparatus which I have specially designed and arranged for the tabulation of statistics relating to the transportation of freight. The apparatus is arranged to classify the data designated upon the record and to totalize and register the items of each class or group separately upon a register as each record is presented to the apparatus, and the special form of apparatus which I have selected for the purpose of this description comprises a controller arranged to coact with a record upon which have been designated four groups of items to be tabulated, four registers—one for each group and each comprising a plurality of indicators, eight in number—arranged in decimal progression from units to tens of millions, actuating mechanism for five of these indicators whereby each of them is controlled directly by the coaction of the controller and the record independently of the action of any other indicator in the register, carrying devices from each indicator to the one next higher in series, resetting devices for moving the indicators to zero when the tabulation of any series of items is completed, a selector which will prevent the operation of the indicators and may also operate a signal in case of error in the selection of a record for tabulation in any series, an arrangement of electrical circuits and devices the action of which is controlled or governed by the record, and other devices and features which will be referred to in the detailed description of the apparatus. This particular form of apparatus is designed for electrical operation and for the tabulation of items of value and amount by the decimal system; but it is apparent that electrical operation is not essential as to many of the important features of my invention and that my invention may be employed for the tabulation of data of any character or description, either by the decimal or any other system of enumeration. Furthermore, the arrangement, form, and character of the record, the number, and especially the construction and arrangement, of the registers, indicators, and actuators and the parts thereof, and the apparatus, devices, and means cooperating therewith may be widely varied without involving any departure from my invention.

In the drawings, Figure 1 represents a general top or plan view of the tabulating apparatus embodying my invention. Fig. 2 is a central transverse sectional view of the preferred form of controller. Fig. 3 is a transverse sectional view of the same, taken upon the plane of the line 3 3 of Fig. 1. Fig. 4 is a transverse sectional view of a selector. Fig. 5 represents a side elevation of one of the registers. Fig. 6 represents a vertical section of the same, taken upon the plane of the line 6 6 of Fig. 8. Fig. 7 represents a vertical section of the same, taken upon the plane of the line 7 7 of Fig. 8. Fig. 8 represents a vertical transverse section of the same, taken upon the plane of the line 8 8 of Fig. 7. Fig. 9 is a top view of certain clutch and starting mechanism employed. Fig. 10 is a front view of the same. Fig. 11 represents a longitudinal section of the same, the plane of section being taken upon the line 11 11 of Fig. 9. Fig. 12 represents a transverse section of the same, the plane of section being taken upon the line 12 12 of Fig. 9. Fig. 13 is a diagrammatic view of the system of electrical circuits employed in this apparatus. Fig. 14 is a view of a record-card suitably prepared for coaction with the controller.

Similar reference characters designate corresponding parts in all the views.

In the tabulation of statistics relating to the transportation of freight the items of each invoice which may be tabulated are, for instance, first, weight, (in pounds;) second, proportional charge, (in dollars and cents;) third,

advance charge, (in dollars and cents,) and, fourth, prepaid charge, (in dollars and cents.) The items are transferred from the way-bills to a record. This is a simplified form for this special work, and for the tabulation of the items referred to consists of a card (shown in in Fig. 14) upon which are printed columns of numerals from "0" to "9," arranged in groups numbered 7, 8, 9, 10, and 11. The group 8 contains numerals for items of weight, group 9 for proportional charge, group 10 for advance change, and group 11 for prepaid charge. Assuming now an entry upon a way-bill from one station (indicated by the number "35") showing weight two thousand one hundred and eight pounds, proportional charge twelve cents, advance charge four dollars, and no prepaid charge, these items are transferred to the record-card by punching out the figures "3" and "5" in columns 1 and 2, respectively, of group 7, indicating the station or series to which the card belongs, the "0," the "2," the "1," the "0," and the "8" in the five columns of group 8, the "0," the "0," the "1," and the "2" in the four columns of group 9, the "0," the "4," the "0," and the "0" in the four columns of group 10, and the four ciphers in the four columns of group 11. These perforations in the record-card will thus correctly represent the items to be tabulated relating to this particular invoice. Items of the same character are similarly transferred to other similarly-prepared cards, each card representing one invoice, and all cards belonging to the same series or station are of course placed together and the items tabulated therefrom, as hereinafter described.

The register 1 is controlled through the perforations in group 8, the register 2 through the perforations in group 9, the register 3 through the perforations in group 10, and the register 5 through the perforations in group 11. The selector 6 is controlled through the perforations in group 7.

The controller to which I have referred is provided with a stationary bed 13 and with a movable platen or "pin-box" 14. The bed 13, upon which a record-card is shown in position, is formed of non-conducting material and has arranged therein a number of cup-like recesses 15, which are partially filled with mercury and which are so arranged that one of said cups will be immediately below each character on the record-card when the latter is placed upon the bed 13 and properly positioned thereon. A binding-post arranged to receive a conducting-wire of the electrical circuit enters each of the mercury-cups. The pin-box 14 is provided with a number of insulated spring-pressed conductive fingers 16, one for each possible perforation in the record-card. These are so arranged that when the platen is brought down by the handle 17 one of the pins, if unobstructed, will enter each mercury-cup. Gages 18 are arranged upon the bed to correctly center the record-card thereon. Each pin is electrically connected in the circuit of the apparatus so as to form the opposite terminal for the cup which it enters. If, therefore, a punched record-card be placed in position upon the bed 13 and the platen 14 be moved downwardly, such of the pins as are opposite the perforations in the card will pass through the perforations and complete an electrical connection between the conductors connecting with the pins and those connecting with the mercury-cups, while the pins which are not opposite perforations will be held back by the record-card and prevented from entering the mercury-cups.

The electrical devices by which this particular apparatus is operated are all connected in series, so that if the circuit be open at any point the indicators will not be operated. I am thus enabled to provide a simple device by which upon failure to insert a card in the controller no action of the registering apparatus will take place when the pin-box or platen is lowered. This consists of the spring 19, carried by the pin-box, and which registers with the opening 20 in the bed 13, and which is arranged to come in contact with the card and be pressed upwardly relatively to the pin-box when the latter is lowered. Two normally-separated metallic spring-tongues 21 and 22, insulated from each other, are carried by the pin-box. When the latter is lowered, the projecting end of the spring 22 will contact with the adjustable circuit-terminal 23, carried by the arm 24. The spring 21 forms the opposite terminal of the circuit. If, therefore, a card be in position when the pin-box is lowered, the descent of the pin 19 will be arrested and will press the spring 21 upwardly into contact with the spring 22, so that the circuit will be closed when the opposite end of arm 22 contacts with the terminal 23. If, however, no card be in the controller the pin 19 will enter the opening 20 and will exert no action on arm 21, so that the circuit will remain open between the terminals 21 and 22. A spring 25 is arranged to return the platen or pin-box to its initial position when the operator releases the handle 17, and a buffer 26 prevents undue shock when the pin-box is rapidly operated.

At each operation of the pin-box, with the record properly perforated and in proper position, a complete circuit is established through the apparatus, and the starting-magnet 27 (shown diagrammatically in Fig. 13 and in detail in Figs. 9 to 12) will be energized and will bring into operative connection a constantly-driven power-shaft 28 and an operating-shaft 42, which runs only when said connection is established. The shaft 28 is journaled in suitable stationary bearings 30 and 31, in which it also is free to move lengitudinally. Secured rigidly to said shaft is the clutch member 32, while the other member, 33, of the clutch is loosely mounted on said shaft and has secured to it the pinion 34. A coil-spring 35 tends to hold the inclined face of the clutch member 33 against the

face of the stationary flange shown as formed integrally with the bearing 31. The clutch member 33 is also provided with an integral inclined face, which is arranged to form the clutch engagement with the member 32.

The armature of the starting-magnet is secured to the lever 36, pivotally mounted upon a fixed support 37, and the outward movement of said lever is limited by the stop 38, while the spring 39 normally holds said lever against said stop. The armature-lever 36 engages with the end of the power-shaft 28, preferably through the medium of the bearing-disks 40. (Shown in Figs. 9 and 11.) The parts are shown in Figs. 9 to 13 in their normal position when the circuit is open and the magnets 27 deënergized. Upon the closing of the circuit the magnet 27 will attract the armature, which will cause the power-shaft 28 to move longitudinally in its bearings, carrying the rotating clutch member 32 into engagement with the member 33 and moving the latter out of engagement with the internal conical face of the flange of the stationary bearing 31. As soon as this is effected the clutch and the shaft 42 will be caused to rotate until the circuit through the starting-magnet is broken, when the spring 39 will force the armature-lever back against the stop 38, and the spring 35 will force the clutch member 33 into engagement with the conical face of the bearing 31, which forms a brake, and thus immediately stops the rotation of said clutch member and of the shaft 42. The bearing-disks 40, one of which is loosely mounted on the shaft 28, permit that shaft to revolve freely notwithstanding the longitudinal pressure exerted by the armature-lever 36.

Upon the shaft 42 is mounted to rotate therewith a pinion 43, which meshes with the spur-wheel 44. The shaft 42 also carries a pinion 77, which meshes with spur-gears on the operating-shaft of each register, and the gears are so proportioned that the register-operating shafts and the spur-wheel 44 will revolve synchronously. The spur-wheel 44 carries a pin 45, which has a cam-like action upon one end of the lever 46, pivotally mounted upon a support 47. The opposite end of said lever carries an insulated stud 48, which loosely engages with a spring contact-tongue 49 in electrical connection with the magnets 27. The tongue 49 is arranged to contact with the terminal 50 when the cam or pin 45 lifts the end of the lever 46 with which it engages when the apparatus is in its non-operating position. When the starting-magnets are energized and the spur-wheel 44 is rotated to carry the pin 45 out of engagement with the lever 46, the lever will rock upon its support and the tongue 49 will immediately contact with the terminal 51, and such contact will be maintained until the wheel 44 is completing its revolution, when it will be broken and contact again established with contact 50.

Each of the registers 1, 2, 3, and 4 will preferably be designated by some inscription which will indicate the character of data which it is to tabulate, and it will be understood that as many registers and as many groups of characters on the records are employed as there are classes of data or statistical items. The construction of the registers is shown most clearly in Figs. 5 to 8. Each register contains any desired number of registering elements or indicators 54. In the operation of registering these indicators necessarily have imparted to them a progressive movement in one direction, and they are preferably, although not necessarily, in the form of revolving wheels or disks. The register 1 (which I have selected for the purpose of detailed description) contains five indicators, which are actuated directly and independently by the actuators, and three additional indicators, which are actuated only by the carrying devices. This register will therefore tabulate directly at one operation single items as large as ninety-nine thousand nine hundred and ninety-nine, and as other items are added the operation of the carrying mechanism will permit the registration of totals as large as ninety-nine million nine hundred and ninety-nine thousand nine hundred and ninety-nine. In the registers 2, 3, and 4, which are controlled by groups containing only four columns of characters, it will be unnecessary to provide means for directly actuating more than four of the indicators. In the form shown and for convenience three sets or series of numerals from "0" to "9," inclusive, are carried on the periphery of each indicator 54. The indicators are journaled to rotate upon the shaft 55, supported by the side frames 56, and an opening 57 is formed in the front 58 of the register. The front 58 is supported by the side frames and serves to conceal the mechanism of the register, as well as all the numerals on the indicators except those which are opposite the opening 57, in which position they indicate a registry. The indicators are provided with peripheral ratchet-teeth, one for each numeral on the indicator. The actuating mechanism 60 for each of the directly-actuated indicators is adapted to impart at each operation each time it traverses its path of movement a variable movement to one or more of the indicators, the extent of which is governed or controlled by the means employed to effect the engagement of the indicators and actuating mechanism. The actuating mechanism which I employ in the special form of register which I am now describing comprises a transverse bar 61, mounted upon side arms 62, loosely journaled on the shaft 55. The side arms 62 are also connected and braced by the transverse bar 63. A pawl 64 for each of the directly-actuated indicators is pivotally mounted at 65 in suitable supports 66, carried by the transverse bars 61 and 63, and a coil-spring 67 for each pawl tends to rock the pawl upon its pivot, so that the pawl when released may engage

the teeth 59 of its indicator. Each pawl has a latch 68, which normally holds it out of engagement with the ratchet-teeth 59 by engaging with the pin 69, with which each pawl is provided. The latch 68 is pivotally mounted at 70 upon the support 66, and a spring 71 (shown in dotted lines, Fig. 7) tends to hold the outer end of the latch up against the bar 63. Connecting-rods 72 connect the side arms 62 with the spur-wheels 74 on each side of the register. The spur-wheels 74 are mounted upon the register-operating shaft 75, journaled in bearings 76, carried by a plate extending across the register and secured to the side frames 56. The spur-gears 74 mesh with the pinions 77, secured to the shaft 42. A single revolution of the spur-gear 74 will therefore cause a reciprocation of the actuating mechanism through a fixed range of movement, such range of movement being at least sufficient to cover nine of the ratchet-teeth on the indicators.

The means which I employ in the form of apparatus herein shown and described for determining the extent of movement imparted to each indicator at each operation or stroke of the actuating mechanism comprises a plurality of electromagnets 78, mounted upon yokes 79, which are secured between a pair of sector-plates 80, carried by the cross-bars 81, which extend between and are supported by the side frames 56. As shown, there are nine magnets for each of the directly-actuated indicators. Each magnet 78 is provided with an armature 82, pivotally supported at 83. Each armature is provided with a hooked end 84, arranged to engage with a tooth 85 upon the tripping-pawl 86, which is pivotally supported at 87. Normally the armature 82 and the pawl 86 are in the position shown in the first and second magnets (counting from the top) of Fig. 7. As stated, each register is controlled by one group of characters on the record, and each of the magnets 78 of each series in each register is controlled by its own corresponding character in one of the columns of the record. Thus the coils of the first magnet (from the top) in the series which effects the engagement between the units-indicator and the actuating devices of the register 1 are electrically and independently connected with a mercury-cup, which is controlled by the character "1" in the units or right-hand column of group 8, the coils of the second magnet in said series with the cup controlled by the character "2" in said column, the coils of the first magnet in the next adjacent series—the series for the tens-indicator—with the cup controlled by the character "1" in the next or tens column of said group, and so on for each magnet in each series in each register. If, therefore, the characters "1" and "2" be punched out of the first two columns of group 8 in the record and the controller be actuated to close the circuit through the perforations to the mercury-cups controlled by such perforations, as previously described, the second magnet of the units series and the first magnet of the tens series will be energized and the tripping-pawls 86 of each of said magnets will be released. If now the indicator-actuating mechanism be moved through its path of movement by the rotation of the spur-wheel 74, the ends of the latches 68 opposite said pawls will be engaged by the latter, lifting their hooked ends and releasing the pawls 64. The pawl of the units-indicator-actuating mechanism will engage that tooth of its indicator which is opposite the second magnet of its series and that indicator will be rotated the distance of two teeth or two of the peripheral numerals. The pawl of the tens-actuating mechanism will engage that tooth of its indicator which is opposite the first magnet of its series, and the tens-indicator will be rotated the distance of one tooth or one numeral, thereby adding twelve to the number previously registered. If a number is to be added which contains a cipher, no movement of the indicator controlled by that column of the record will be necessary; but it will be necessary with the arrangement of circuits which I have already described to punch out the ciphers where they occur in any number to be added. A resistance-coil 94 is therefore provided in each series of magnets and is connected with each of the mercury-cups controlled by the ciphers in each column of the record, the resistance of said coil being equal to the resistance of the coils of one of the magnets 78. After the latches 68 have been tripped the upward movement of the indicator-actuating mechanism will cause the rotating wheels 89 to engage with such of the pawls 86 as have been released and will press the same backwardly, and the hooked end of the armature will reengage the tooth 85 on each of such pawls and will retain it in its normal non-operating position, its magnet having at this period of the operation of the register been deënergized by the action of the spring-tongue 49, previously described. I have provided the hooked end of each armature 82 with a pin 90, and a projection 91 upon each pawl 86 carries a cam-like surface, which is so arranged relatively to the pin that when a pawl is pressed back by the wheel 89 the cam 91 will engage the pin 90, lifting that end of the armature and positively separating the armature and magnet-poles, thus overcoming any tendency of the armature to stick should there be sufficient residual magnetism in the poles after the circuit is broken to overcome the force of the spring 88.

In the apparatus shown the limit of the forward movement of the indicator-actuating mechanism is reached when the spur-wheel 74 has completed a half-revolution from its normal non-operating position, and the remainder of the revolution of the spur-wheel carries said actuating mechanism back to its initial position, thus, as will be more fully

described hereinafter, each operation of the apparatus or of the controller producing one forward and return movement or one complete operation of the actuating mechanism through its fixed range or path of movement. As the actuating mechanism approaches the end of its complete movement due to one complete revolution of the spur-wheel 74, the pawls 69, which have been tripped during the forward movement of the actuating mechanism, will be reset or returned to their initial position by the engagement of their lower ends with the bar 92, rigidly supported by the arms 93, secured at each side of the register to the cross-bar 81.

The carrying devices between the indicators are arranged in the special form of register illustrated to carry each tenth unit of movement from each indicator to the one next higher in the series, and as the direct movement of the indicators by their actuating means is produced on the forward movement of the latter I have arranged the carrying devices to operate on the return movement, so that the two movements of the indicators shall not conflict. The carrying device comprises a plurality of bell-crank levers 96, journaled upon a stationary shaft 97. Said levers are provided with one vertical and two horizontal arms. The vertical arm carries a spring-actuated pawl 98, which engages with the teeth 59 of the indicator which is actuated by the carrying device. The forwardly-extending horizontal arm of each lever is provided with a pin 99, which engages with a latch-lever 100, pivotally mounted upon a fixed pin 101, carried by a plate 102, secured to the side frames of the register. The indicators are provided with three pins or studs 103, (shown in Fig. 7 in dotted lines and in Fig. 8 in full lines,) one for each series of numerals on the indicators. The upper end of the latch-lever 100 is provided with an inclined face, which lies in the path of the studs 103 on the indicator from which the carrying device is actuated. Thus in carrying from units to tens the pawl 98 will engage with the tens-wheel, while its latch 100 will engage the studs on the units-wheel. The studs 103 are so arranged on the indicators that as the indicators are actuated to move the numeral "9" of any series of numerals on any indicator below the sight-opening 57 the stud for that series of numerals will engage with the inclined face of the lever 100 and will rock said lever and release the pin 99 on the bell-crank lever, and under the action of spring 105 the vertical arm of said lever will be drawn forward until arrested by the engagement of the forwardly-extending horizontal arm with the cross-bar 106. The parts are so proportioned that this forward movement of the bell-crank lever produced by the action of the stud on one indicator of the series will cause the pawl to move over and pick up one ratchet-tooth on the next higher indicator. Springs 107 tend to hold the latch-levers in operative position. A shaft 108 carries a series of radial cams 111, one for each bell-crank lever. Gears 109 and 110 cause said shaft to rotate with shaft 75, but in the opposite direction, so that the cams 111 will be rotated in the direction shown by the arrow in Fig. 7. The rearwardly-extending arms 112 of the bell-crank levers 96 carry antifriction-rollers 113, which are moved up into the path of the cams 111 when said levers are released by the latch 100 and drawn forward by the spring 105. Assuming now that the register shows a registry of "99," "9" on the units and "9" on the tens-indicator, and the actuating devices by the means to be presently described are actuated to add six to this number, one of the studs 103 will by the movement of the units-indicator release its latch-lever as the numeral "9" thereon passes below the sight-opening. The indicator will be moved until the numeral "5" appears opposite the opening and will there rest as the indicator-actuating means reaches the limit of its forward movement. By the release of the latch-lever the bell-crank lever 96 controlled thereby is also released, and the pawl 98 will be drawn forward to pick up one ratchet-tooth on the tens-indicator. The roller 113 on the bell-crank lever will be at the same time thrown into the path of the cam 111 nearest the left-hand side of the register, Fig. 8. The cams 111 are arranged in angular relation with each other upon the shaft 108, so that they will come into operative position successively, beginning with the cam at the left, just referred to, which is adjusted to engage the roller 113 as soon as the indicator-actuator commences its return movement. The engagement of said cam with said roller will force the arm 112 and roller 113 downwardly. The cams 111 are so proportioned that the movement of the bell-crank lever so produced will move the pawl 98 and the indicator with which it engages (the tens-indicator) the distance of one tooth, or from "9" to "0," bringing the cipher opposite the sight-opening. This movement of the tens-indicator will release its latch 100 in exactly the same way as the latch for the units-indicator was released and will throw the roller 113 on the second bell-crank lever into the path of the second cam. The continued rotation of the cam-shaft 108 during the return of the indicator-actuator means will cause this cam to move the pawl which engages the hundreds-indicator the distance of one tooth, which will move the hundreds-indicator from "0" to "1," and the registry will be "105," no further action of the indicators occuring during the remainder of the return movement of the actuators. As the arms 112 are forced down by the cams the pin 99 on the opposite horizontal arm of the bell-crank lever will ride up the beveled lower end 114 of the latch 100, forcing the latch back and permitting the pin to reëngage the hook formed therein.

The resetting device, by which all the in-

dicators of each register are returned to their initial or zero position after the completion of one tabulation, comprises a resetting-lever 117, rigidly secured to the shaft 55, to which are also rigidly secured the arms 118. A bar 119, provided with a series of pawl-like fingers 120, one for each indicator, is pivotally mounted in the arms 118. A spring 121 tends to hold an arm on the bar 119 against the stop 122, carried by one of the arms 118. In the normal or non-operating position of the bar 119, however, the fingers 120 will rest upon the studs 103 of such of the indicators as are in their initial or zero position, the arm on the bar 119 being lifted clear of engagement with the stop 122; but when deprived of the support afforded by the studs 103, either by the rotation of the indicators or the forward movement of the bar, the latter under the action of spring 121 will cause the bar to rotate slightly until its arm contacts with the stop 122. The studs 103 on such indicators as have been advanced from their zero position will then lie in the path of the ends of the fingers 120 when the latter are moved forward by operating the resetting-lever 117, which will rotate the shaft 55 and carry forward the arms 118 and finger-bar 119. The resetting-lever 117, and consequently the fingers 120, are limited in their forward movement by the stop 123, secured to the side frame 56, Fig. 5, and in their return movement by the engagement of the arm 132 of the resetting-lever with the lug 131, carried by the spring-tongue 129. If, therefore, any of the indicators have been advanced from their zero position, so that any of the numerals from "1" to "9" appear opposite the sight-opening 57, when the resetting-lever 117 is actuated, as described, the fingers 120 of all the indicators which have been advanced will in their forward movement engage the studs 103 and rotate said indicators until the zeros of the next series of numerals appear opposite the opening 57, when their movement will be arrested by the engagement of the lever 117 with the stop 123. The indicators will then all read zero. The pawls 115 will prevent any movement of the indicators during the return movement of the resetting devices, and when the return movement of the latter is arrested by the lug 131 the fingers 120 will all rest on the studs 103 belonging to the next series of numerals on the indicator.

With the special form of indicators which I have herein shown and described, when the indicators are moved forward by the engagement of the fingers 120 with the studs 103 the studs of the preceding series of numerals on the indicators so advanced will, owing to the relative arrangement of the parts, engage with and trip the latch-levers 100 of such indicators. To prevent the tripping of the levers 100 from releasing the carrying mechanism, (which would then be operated on the next return movement of the actuators,) I provide a spring-actuated bar 124, carried by the pivoted arms 125, which are mounted on the studs 126, projecting from the side frames 56. The bar 124 extends across the front of the register and normally stands away from the bell-crank levers 96, so as not to interfere with their regular operation; but when the resetting devices are actuated the cams 127, secured to the shaft 55, will engage with the rollers 128, carried by each of the pivoted arms 125, swinging the bar 124 in against the bell-crank levers 96 and holding the latter, so as to prevent the pawls 98 from being drawn forward by springs 105 if the latches 100 are released. The levers 96 are thus held firmly against movement during the remainder of the resetting movement of the indicators.

To prevent the accidental operation of the register while the indicators are being reset and to insure the return of the resetting devices to their proper position, I provide a circuit-controlling device consisting of the spring arms or contacts 129 and 130, insulated from each other at their points of support and each forming a terminal for the circuit through the magnets 78. The arm 129 carries a lug 131, and when the resetting-lever is in its normal position, as shown in Fig. 5, the lower end of the arm 132 bears against said lug and holds the arms 129 and 130 in contact; but when the arm 117 is moved even slightly from the position shown the arm 132 will be carried out of engagement with the lug and the resiliency of spring 129 will cause it to spring upwardly. Its contact-point will be separated from that of the arm 130 and the circuit will be opened at this point and will remain open until the resetting-lever and the devices connected therewith are returned to their normal position.

The selector to which I have previously referred is shown diagrammatically in Fig. 13 and in detail in Fig. 4. It is designated by the reference character 6 and comprises two rows of contact-springs 133, one for each column of characters in group 7 of the record shown in Fig. 14. Each of the springs 133 is electrically connected with its corresponding mercury-cup of the controller. For instance, the fourth spring from the top in the left-hand row, Fig. 13, is connected with the cup corresponding with the "3" in the tens-column of group 7 and the sixth spring in the right-hand row with the cup corresponding with the "5" in the units-column of the same group. In front of each row of springs are conducting-bars 134, having plug-holes corresponding to the springs 133. The springs normally contact with the conducting-strips 136; but such contact is broken by the insertion of the plugs 135, as shown in Fig. 4. When the plugs are inserted in the proper holes and the cards presented to the controller are properly punched for the series corresponding to the location of the plugs, the circuit through the controller will be properly completed, as will be described presently; but if a record belonging to another series be accidentally

inserted in the controller, so that the current reaches any of the springs not in contact with the switch-plugs, a circuit will be completed through the conducting-strips 136 and the lamp 137. Thus the circuit through the controller will not be completed, the apparatus will fail to register, and the operator will be notified of the error by the flashing of the lamp or by such other signal as may be substituted therefor. I have shown a selector which will include ninety-nine series. Obviously its capacity may be increased indefinitely, and, if desired, the remainder of the apparatus may be operated without employing the selector, which is used only for the purpose of detecting error in the sorting or classification of the cards. In case the selector be not employed it is to be cut out of circuit by throwing the switch from the contact 140 to the contact 141.

Should there be no number to be registered on any one of the registers, it will be necessary in employing the apparatus I have already described to punch out all the ciphers in that group of the record which controls such register in order to establish the circuit through the apparatus. If the omitted items are sufficiently numerous, however, I obviate the necessity of so much punching by making a single perforation in the record-card, whereby any one or more of the registers may be entirely cut out of circuit. For this purpose I provide the record with a character or series of characters, one for each register which it is desired to cut out of operation. For these characters corresponding pins and mercury-cups are arranged in the controller. To simplify the drawings and description, I have shown and will describe means by which only the register 4 is cut out of operation; but it will be readily understood that any one or more of the registers may be similarly arranged. In preparing a record where there is no item to be registered in group 11 (on register 4) the character "X" is punched out and no perforations are made in group 11. The pin and mercury-cup controlled by this perforation are connected, respectively, with the terminal 130 on register 3 by the conductor 162, Fig. 13, and by the return-conductor 159 to the generator 52 through the resistance 163, the resistance of which is intended to equal that of the register 4. The circuit will thus, upon the operation of the controller, be established around the register 4 from the terminal 130 of register 3 to the return-wire 159.

In addition to the spring-pins and mercury-cups corresponding to the characters delineated upon the record certain other spring-pins and cups 144 and 152 are arranged in the controller just outside of the edges of the card when it is properly inserted in the controller, so that if the card be not correctly placed in the controller these pins will strike the card when the controller is operated and the circuit through the system will remain open at these points. Any desired number and arrangement of these safety contact-pins may be employed.

The apparatus which I have herein shown and described as embodying my invention in one of its forms arranged for the class of work referred to is operated as follows: The record-cards pertaining to one series having been properly punched, the switch-plugs 135 are inserted in the selector, so as to engage the springs connected with the mercury-cups controlled by the perforations of the series being tabulated. In the case of the card illustrated the plugs would be inserted in the fourth hole in the left-hand and in the sixth hole in the right-hand bars 134. A record-card is then inserted in the controller, the handle 17 is depressed, and assuming that this particular card be punched, as shown in Fig. 14, the circuit will be completed as follows: From the generator 52 by conductor 142, switch 138, conductor 143 to the controller contact-terminal 23, through spring-contacts 21 and 22, safety contact-pin and cup 144, conductor 145, switch 139, conductor 146 to all the spring-pins controlled by the first or tens column of the selector group 7 of the record, to the mercury-cup controlled by character "3" in said column, thence by one of the conductors in the cable 147 to the fourth spring (from the top) in the tens or left-hand column of the selector, through the plug which connects the same to the bar 134, to conductor 148, to the pins controlled by the units-column of group 7, to the mercury-cup controlled by the character "5" in said column, by one of the conductors in cable 150 to the sixth spring of the selector, through the conducting-plug in contact therewith to its bar 134 and conductor 151 to the safety contact-pin and cup 152, to the pins controlled by the fifth column (that at the left) of group 8, to the mercury-cup controlled by the cipher of said column, (that character having been punched,) through its conductor carried by cable 153 to the resistance-coil in the corresponding or fifth series of magnets in register 1, (this, as shown in the diagram, being the outside series,) by the return-conductor 95 to the coils of the second magnet in the fourth series, (releasing the tripping-pawl of such magnet,) by the conductor in cable 154 to the mercury-cup controlled by the character "2" in the fourth column of group 8, (that character having been punched,) through the spring-pin for said cup to a common return for all the pins controlled by the fourth and third columns of said group, to the mercury-cup controlled by the character "1" of the third column, by its conductor carried by the cable 155 to the first magnet in the third series, (releasing the tripping-pawl of such magnet,) thence to the resistance connected with the second series of magnets, thence by the conductor carried by the cable to the mercury-cup controlled by the cipher in the second column of group 8 of the record, to its pin and to the common return for all the pins

controlled by the first and second columns of group 8, thence to the cup controlled by the "8" in the first or units column of said group, thence by the conductor carried by the cable to the coils of the eighth magnet in the first series of magnets, (releasing the pawl of such magnet,) thence by conductor 156 to the spring-contact 129, to the contact 130, and thence to the register 2, and so on through the magnet or resistance coils of each register and through the controller, as described for the register 1. In each register the tripping-pawls 86 of the magnets corresponding with perforations in the record-card will be released as the circuit is completed through the magnet-coils. From the contact 130 of the last register, 4, the current will pass by conductor 159 to the contact 50 through the conducting-strip 49 and the coils of the starting-magnet 27, back to the generator. Immediately upon the completion of the circuit, as described, by the lowering of the pin-box the coils of the starting-magnet are energized and the clutch mechanism, Figs. 9 to 11, is operated thereby to throw the constantly-driven shaft 28 into gear with the shaft 42, which will rotate the shaft 42, carrying the pinion 77, which meshes with the spur-wheels 74 of each register, and will also rotate the wheel 44, Figs. 9 and 12, and carry the pin 45 out of engagement with the lever 46, thereby throwing the conducting-strip 49 out of contact with terminal 50 and into contact with terminal 51, breaking the circuit through the registers and controller and establishing the circuit from the generator through conductor 160, resistance 53, contact 51, conducting-strip 49, conductor 165, magnet 27, and back to the generator. The shifting of the circuit through the starting-magnets is practically instantaneous and does not stop the rotation of the spur-wheels 74, which are started as soon as the circuit is first completed through the controller and which, notwithstanding the breaking of the circuit through the controller by its return to its initial position, continue their movement when the circuit is shifted to the control of the motor (through the action of the pin 45 on wheel 44) until said wheel 44 makes one complete revolution, when the pin 45 will again engage lever 46 and carry the strip 49 out of contact with terminal 51 and into contact with terminal 50. This will instantly stop the rotation of the spur-wheels 74, owing to the release of the armature-lever 36 and the clutch mechanism and the engagement of the clutch member 34 with the stationary bearing 31. Returning to that point in the operation of the apparatus at which the pin-box has been lowered to complete the circuit through the prescribed magnets and the corresponding tripping-pawls have been released, the rotation of the spur-wheels 74 will operate the indicator-actuating mechanism and cause the tripping-pawls to release the pawls of the actuating mechanism, which will engage the indicators, moving the latter to register the numerals punched in the record. This is accomplished during the first half-revolution of the spur-wheels 74. During the remainder of the revolution on the return movement of the actuating mechanism the carrying devices are operated and the actuator-pawls are reset. By this operation the number "2108" will have been added to the registry of register 1, "12" to the register 2, "400" to the register 3, and nothing to the register 4. As soon as the control of the starting-magnets has been shifted from the controller the pin-box is released and returns to its initial position. The card is removed and another inserted. By this time the revolution of the operating mechanism will have been completed and the pin-box is again lowered, another operation of the apparatus is effected, and another series of items is added to those previously registered, and so on, until the tabulation is completed, when the total registry is suitably recorded and the indicators are all reset for another tabulation.

Having thus shown and described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination of one or more indicators, actuating mechanism therefor, a plurality of devices for controlling the engagement of each indicator with the actuating mechanism and record-controlled means for actuating one only of said devices at each operation of the machine to impart a variable movement to the indicator.

2. The combination of one or more indicators, actuating mechanism therefor, engaging mechanism for connecting each indicator with the actuating mechanism, a plurality of devices for operating the engaging mechanism for each indicator and record-controlled means for actuating one only of said devices at each operation of the machine to impart a variable movement to the indicator.

3. The combination of a variably-movable registering-indicator, actuating mechanism therefor having a fixed range of movement, a perforated record and means controlled by the perforations in the record for determining the extent of movement imparted to the indicator at each operation of the actuating mechanism.

4. The combination of a plurality of registering-indicators, actuating mechanism for the indicators adapted to impart a variable movement thereto, a perforated record and means controlled by the perforations in the record for determining the extent of movement to be imparted to each indicator at each operation of the actuating mechanism.

5. The combination of a plurality of variably-movable registering-indicators, actuating mechanism for the indicators having a fixed range of movement, a perforated record and means controlled by the perforations in the record for determining the extent of move-

ment to be imparted to each indicator at each operation of the actuating mechanism.

6. The combination of one or more indicators, actuating mechanism for the indicators, a single engaging device for each indicator carried by the actuating mechanism, a plurality of operating devices therefor arranged along the path of movement of each engaging device and each controlling the engagement of the indicator and its actuator at a different point in the movement of the actuating mechanism and record-controlled means for operating one of said operating devices at each movement of the actuating mechanism to impart a variable movement to the indicator.

7. The combination of one or more indicators, actuating mechanism therefor, a record, an engaging device for each indicator carried with the actuating mechanism and means controlled by the record and the movement of the actuator for operating the engaging device at a predetermined point in the movement of the actuating mechanism.

8. The combination of one or more indicators, actuating mechanism therefor, a record, an electrically-actuated engaging device for each indicator and circuit-closing devices controlled by the record for operating said engaging device at different points in the movement of the actuating mechanism, the point at which the engaging device is operated being determined by the record.

9. The combination of a plurality of registering-indicators, actuating mechanism therefor, a motor for operating the same, connecting mechanism between the actuating mechanism and the motor and electrically-controlled devices for operating said connecting mechanism.

10. The combination of a plurality of registering-indicators, a motor for operating the same, connecting mechanism between the indicators and the motor and electrically-controlled means for actuating the connecting mechanism for each indicator independently.

11. The combination of a plurality of registering-indicators, a motor for operating the same, connecting mechanism between the indicators and the motor, a record and means controlled by the record for actuating the connecting mechanism for each indicator independently.

12. The combination of a plurality of registering-indicators, actuating mechanism, a motor for operating said mechanism, record-controlled means for connecting each indicator with said mechanism, connections between the motor and said actuating mechanism and electrically-controlled means for operating said connections.

13. The combination of a plurality of indicators, actuating mechanism for the indicators, record-controlled means for determining the extent of movement imparted to each indicator at each operation of its actuating mechanism and carrying devices adapted to operate after the indicators have been moved by the actuating mechanism.

14. The combination of a plurality of indicators, actuators adapted on one movement to impart a movement to the indicators, record-controlled means for determining the extent of movement imparted to each indicator during such movement of its actuator and carrying devices between the indicators arranged to be operated during the opposite movement of the said actuators.

15. The combination with a plurality of indicators, actuating mechanism adapted in its movement to impart a movement to the indicators, a record and means controlled by the record for variably determining the extent of movement imparted to each indicator during the movement of the actuating mechanism and carrying devices between the indicators adapted to be operated during the return movement of the actuating mechanism.

16. The combination of a registering-indicator, actuating mechanism therefor, record-controlled means for controlling the movement of the indicator and a selector for controlling the operation of the actuating mechanism.

17. The combination of a registering-indicator, actuating mechanism therefor, record-controlled means for determining the extent of movement imparted to each indicator at each operation of its actuating mechanism and a selector for controlling the operation of the actuating mechanism.

18. The combination with the indicators and their actuating mechanism, of record-controlled means for determining the extent of movement imparted to each indicator at each operation of its actuating mechanism, a selector for controlling the operation of the actuating mechanism and a signal controlled by the selector.

19. The combination with an indicator, an actuator therefor, means for moving the actuator, record-controlled means for determining the extent of movement imparted to the indicator at each operation of its actuator, a selector governing the means for imparting movement to the actuator and a signal under the control of the selector and operated when the actuator fails to impart movement to the indicator.

20. The combination of variably-movable indicators, actuating mechanism therefor, an engaging device for connecting each indicator with its actuating mechanism and electrically-controlled devices for operating said engaging devices to determine the extent of movement imparted to the indicator at each operation of the machine.

21. The combination with the variably-movable indicators, of actuating mechanism having a fixed range of movement, an engaging device for connecting each indicator with its actuating mechanism, means for operating said engaging device at a predetermined point in the movement of the actuating mechanism,

a motor, and electrically-controlled means for connecting and disconnecting the actuator and motor.

22. The combination of an indicator, an actuator therefor, an engaging device for the indicator carried with the actuator and record-controlled means for operating the engaging device at a predetermined point in the movement of the actuator.

23. The combination of an indicator, an actuator therefor having a fixed range of movement, a pawl carried with said actuator and adapted to engage with the indicator, a record-card and means controlled by the record-card for tripping the pawl at a predetermined point in the movement at the actuator.

24. The combination of a plurality of indicators, actuating mechanism therefor, pawls carried by the actuating mechanism for engagement with the indicators and record-controlled means by which said pawls may be tripped at predetermined points in the movement of the actuating mechanism.

25. The combination with the indicators and their actuating mechanism, of a pawl carried by the actuator, means for tripping the pawl at a predetermined point in the movement of the actuator, a motor and electrically-controlled means for connecting and disconnecting the actuator and the motor.

26. The combination with the indicators and their actuating mechanism, of a pawl carried thereby for each indicator, record-controlled means for tripping the pawl at a predetermined point in the movement of the actuating mechanism, and means for resetting the pawl after the indicator has been moved.

27. The combination with one or more indicators and their actuating mechanism, of a pawl for each indicator carried by the actuating mechanism, a latch for holding the pawl out of engagement with the indicator, and record-controlled means for operating the latch to trip the pawl at a predetermined point in the movement of the actuating mechanism.

28. The combination with a plurality of registers, each having a plurality of indicators, of actuating mechanism in each of the registers for the indicators therein, record-controlled means for determining the extent of movement imparted to the indicators by the said actuating mechanism, and means operated thereby for preventing the movement of the actuating mechanism in one or more of the registers.

29. In a tabulating apparatus, the combination with the indicators and actuating devices therefor, of a record, means controlled thereby for starting the actuating devices and means for completing the stroke or movement of the actuating devices independently of the actuator-starting means.

30. In a tabulating apparatus, the combination with the indicators and actuating devices therefor, of a shaft for imparting movement to the actuating devices, a record, means controlled thereby for operatively connecting said shaft with a motor to start the actuating devices, means controlled by the record for releasing the connection between said shaft and the motor from the control of the record and maintaining said connection independently of the record control, and means for releasing the shaft from connection with the motor upon the completion of one movement of the actuating devices.

31. In a tabulating apparatus, the combination of a record, a motor, the indicators and their actuating mechanism, a clutch adapted to connect the latter with the motor, a magnet controlling the clutch, record-controlled means for controlling the circuit through the magnet to start the indicator-actuating mechanism, and means actuated by the motor for shifting the control of the magnet to a circuit not controlled by the record, and means for releasing the connection between the motor and the indicator-actuating means and arresting the movement of the latter at the end of their prescribed movement.

32. The combination of the indicators and actuating devices, a clutch to connect the latter with a motor, a magnet controlling said clutch, a record-controlled means by which the circuit through the magnet is completed to operate the clutch and start the actuating devices, a switch operated by the motor to break said circuit and maintain a circuit through the magnet independently of the record-controlled means during the prescribed movement of the actuating devices, and means for actuating said switch to break the latter circuit upon the completion of said movement of the actuating devices.

33. The combination of an indicator, an actuator therefor adapted at each operation to impart a variable movement to the indicator, record-controlled means for determining the extent of movement to be imparted to the indicator at each operation of the actuator, a resetting device for the indicator, and means for preventing the movement of the actuator during the operation of the resetting device.

34. The combination of an indicator, a record, devices electrically controlled by the record for operating the indicator, a circuit-controlling device by which the circuit which controls the operation of the indicator is normally closed, a resetting device for the indicator, and means for operating said circuit-controller to open said circuit when the resetting device is being operated.

35. The combination of a plurality of indicators, a record, devices electrically controlled by the record for operating the indicators, a circuit-controlling device by which the circuit which controls the operation of the indicators is normally closed, a resetting device for the indicators, and means for operating said circuit-controlling device to open said circuit when the resetting device is being operated.

36. The combination of a plurality of indicators, record-controlled means for operating

the indicators, carrying devices between the indicators, a resetting device for the indicators, and means actuated by the resetting device for locking the carrying devices while the indicators are being reset.

37. The combination of a plurality of registers having indicators therein, electrically-operated devices for actuating the indicators, a resetting device for each register, and means operated by any one of the resetting devices for breaking the circuit through all the registers.

38. The combination of a series of indicators, record-controlled means for actuating the indicators, a lever for each of said indicators, means operated by each indicator for releasing its lever when the indicator is moved beyond the maximum registry, means operated by said lever for engaging with the indicator next higher in the series, and means for actuating such lever to move the higher indicator one space after the indicator by which the lever has been released has been actuated by the record-controlled means.

39. The combination of a series of indicators, actuating mechanism therefor, record-controlled means for operating said mechanism to impart movement to the indicators by the one movement of the actuators, a lever for each of said indicators, means operated by each indicator for releasing its lever when the indicator is moved beyond its maximum registry, means operated by said lever for engaging with the indicator next higher in the series, and means for actuating the lever to move the higher indicator one space upon the return movement of the actuator.

40. The combination of a series of indicators, actuating mechanism therefor, a lever for each indicator, a latch arranged to hold the lever in its normal position, means carried by the indicator for releasing the lever from its latch, a pawl carried by the lever and arranged to engage with the indicator next higher in the series, cams arranged to engage with said levers after their latches have been released, means for operating the indicators by the movement of the actuating mechanism in one direction, and means for effecting on the opposite movement of the actuating mechanism the engagagement of said cams with the levers that have been released, to move forward one space the indicators with which the pawls of such levers are engaged.

41. The combination of a registering-indicator, a series of electromagnets controlling the movement of the indicator and a record-controlled circuit-closing device for each magnet.

42. The combination of a registering-indicator, a series of electromagnets and record-controlled means for energizing any one of said magnets to determine the extent of movement of the indicator at one operation.

43. The combination of a registering-indicator, a series of independently-connected electromagnets governing the movement of the indicator, a circuit-closing device for each magnet and a record for controlling the circuit-closing devices.

44. The combination of a registering-indicator, an actuator therefor, a series of electromagnets and record-controlled means for energizing any one magnet of the series to determine the extent of movement of the indicator.

45. The combination of a registering-indicator, an actuator therefor, a series of electromagnets and record-controlled means for operating the actuator and energizing any one magnet of the series to determine the extent of movement of the indicator.

46. The combination of an indicator, an actuator therefor, a series of electromagnets by which the point at which the actuator will engage the indicator is determined and record-controlled means by which the actuator is operated and the predetermined magnet of the series is energized to effect the engagement of the actuator and indicator.

47. The combination of an indicator, a movable actuator, devices arranged successively in the path of the actuator for controlling its engagement with the indicator, a series of electromagnets, each governing the action of one of said devices and record-controlled means for energizing a predetermined magnet of the series.

48. The combination of a plurality of registering-indicators, a series of electromagnets for controlling the movement of each indicator and a record-controlled circuit-closing device for each magnet.

49. The combination of a plurality of registering-indicators, a series of electromagnets for each of said indicators and record-controlled means for energizing any one of said magnets in each series to determine the extent of movement of one or more indicators at one operation.

50. The combination of a plurality of registering-indicators, a series of independently-connected electromagnets for each indicator governing the movement thereof, a circuit-closing device for each magnet, and a record controlling the circuit-closing devices.

51. The combination of a plurality of registering-indicators, actuating mechanism for each indicator, a series of electromagnets for each indicator and record-controlled means for energizing any one of the magnets of each series to determine the extent of movement of each indicator.

52. The combination of a plurality of indicators, actuating mechanism for each indicator, a series of electromagnets for each indicator and record-controlled means for operating the actuating mechanism and energizing any one of the magnets of each series to determine the extent of movement of the indicator.

53. The combination of a plurality of indicators, actuating mechanism for each indi-

cator, a series of electromagnets for each indicator by which the point at which the actuating mechanism will engage the indicator is determined and record-controlled means by which the actuating mechanism is operated and the predetermined magnet in each series is energized to effect the engagement of the indicator and its actuating mechanism.

54. The combination of a plurality of indicators, movable actuating mechanism for the indicators, devices for each indicator arranged successively in the path of the actuating mechanism for controlling its engagement with its indicator, a series of electromagnets for each indicator, each magnet governing the action of one of said devices, and record-controlled means for energizing a predetermined magnet in each series.

55. The combination of a plurality of registering-indicators, actuating mechanism having a fixed range of movement, electromagnets controlling the engagement of the indicators and actuating mechanism, and means for establishing a circuit through said magnets at a predetermined point in the movement of the actuating mechanism to determine the extent of movement to be imparted to each indicator by each movement of its actuating mechanism.

56. The combination of a plurality of registering-indicators, actuating mechanism therefor having a fixed range of movement, electrically-actuated devices for controlling the engagement of each indicator with the actuating mechanism, and means for actuating the same to effect the control of each indicator at a predetermined point in the movement of the actuating mechanism.

57. The combination of a plurality of registering-indicators, actuating mechanism therefor, electromagnets controlling the engagement of the actuating mechanism and indicators, and means for establishing a circuit through the magnets for determining the extent of movement imparted to each indicator at each operation of the machine.

58. The combination of a plurality of indicators, actuating mechanism for the indicators, a pawl for each indicator carried by the actuating mechanism, a series of electromagnets for each indicator, a device controlled by each magnet for releasing one of the pawls to engage with its indicator, and record-controlled means for energizing any of the magnets of any series to release the pawl, carried by the actuating mechanism, for that series at a predetermined point in the movement of the latter.

59. The combination of a plurality of indicators, actuating mechanism therefor, a pawl carried by the latter, a series of electromagnets for each indicator, a tripping device controlled by each magnet for releasing one of the pawls to engage with its indicator, record-controlled means for energizing any one of the magnets of any series to release the pawl, carried by the actuating mechanism, for that series at a predetermined point in its movement, and means for resetting the tripping device.

60. The combination of a plurality of indicators, actuating mechanism for the indicators, a pawl for each indicator carried by the actuating mechanism, a series of electromagnets for each indicator, a tripping device controlled by each magnet for releasing one of the pawls to engage with its indicator, record-controlled means for energizing any one of the magnets of any series to release the pawl for that series at a predetermined point in its movement, means carried by the actuator for resetting the tripping device, and a detent for holding the tripping device when reset.

61. The combination of an electromagnet, an armature therefor, a pawl arranged to be released by the attraction of the armature, a detent for holding said pawl set and a cam actuated by the resetting of the pawl to carry the armature out of contact with the poles of the magnet.

62. The combination of an electromagnet, an armature therefor, a pawl arranged to be released by the attraction of the armature, means for resetting said pawl, a cam carried by the pawl and actuated by the resetting thereof to carry the armature out of contact with the poles of the magnet.

63. The combination of an indicator, a series of electromagnets for each indicator, record-controlled means for energizing any one magnet of the series to determine the extent of movement imparted to the indicator and a record-controlled selector governing the operation of the magnets.

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Witnesses:

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No. 685,608. Patented Oct. 29, 1901.

H. HOLLERITH.

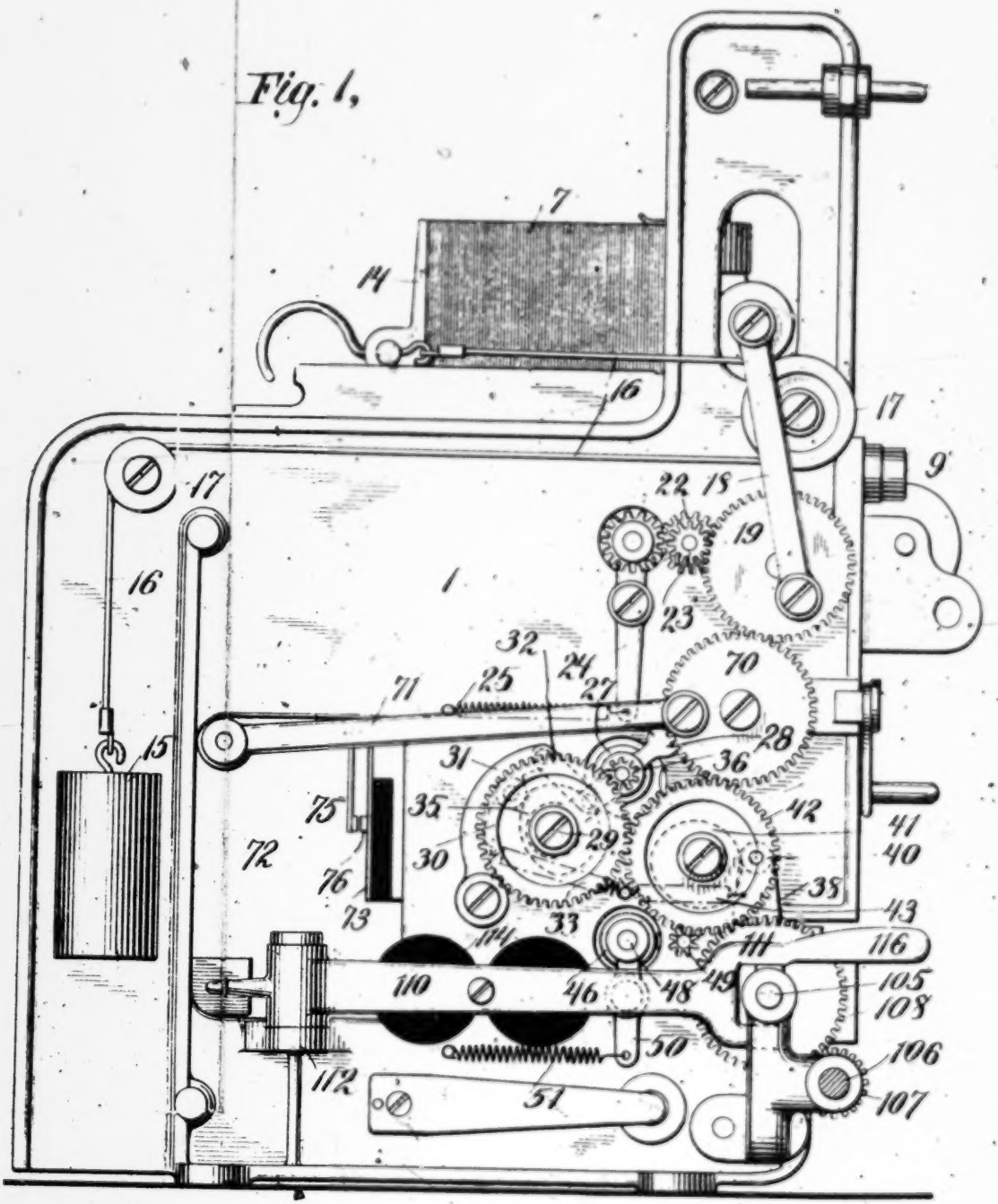
TABULATING APPARATUS.

Application filed Mar. 18, 1901.

(No Model.)

12 Sheets—Sheet 1.

Fig. 1.



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BY

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ATTORNEYS.

No. 685,608. Patented Oct. 29, 1901.

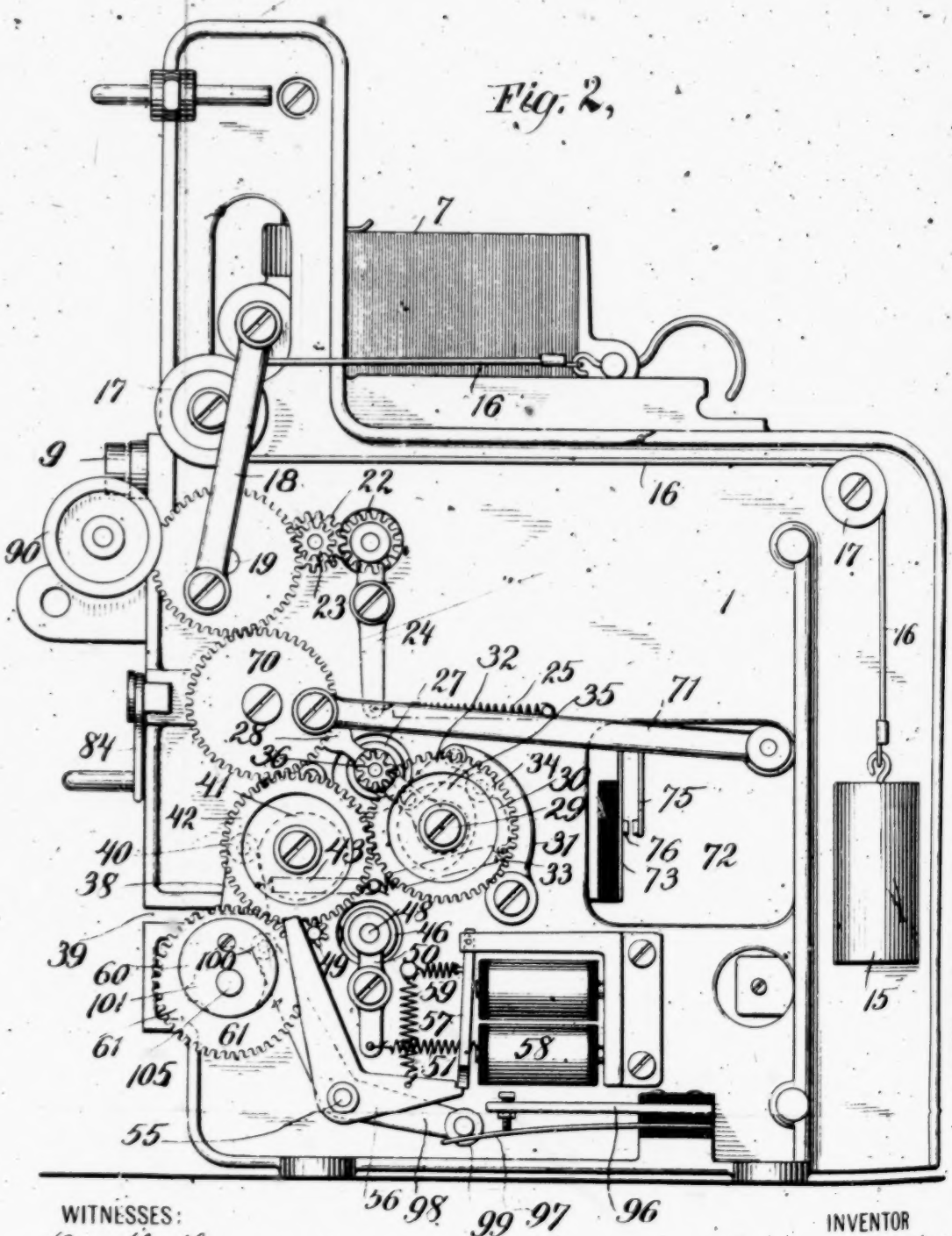
H. HOLLERITH.

TABULATING APPARATUS.

(Application filed Mar. 13, 1901.)

(No Model.) 12 Sheets—Sheet 2.

Fig. 2.



WITNESSES:

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Lauchlin McLean.

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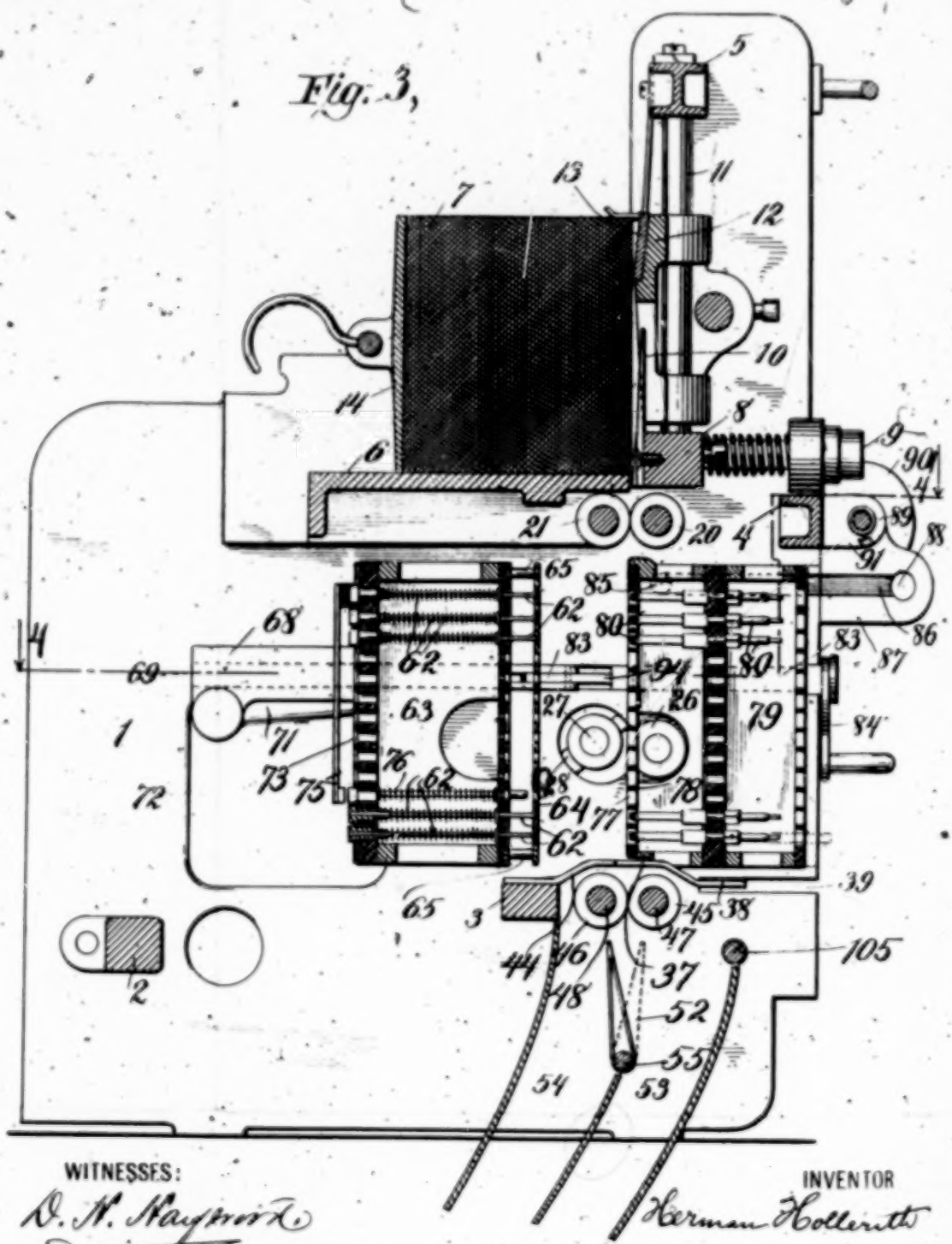
(No Model.) 12 Sheets—Sheet 3.

Fig. 3.



WITNESSES:

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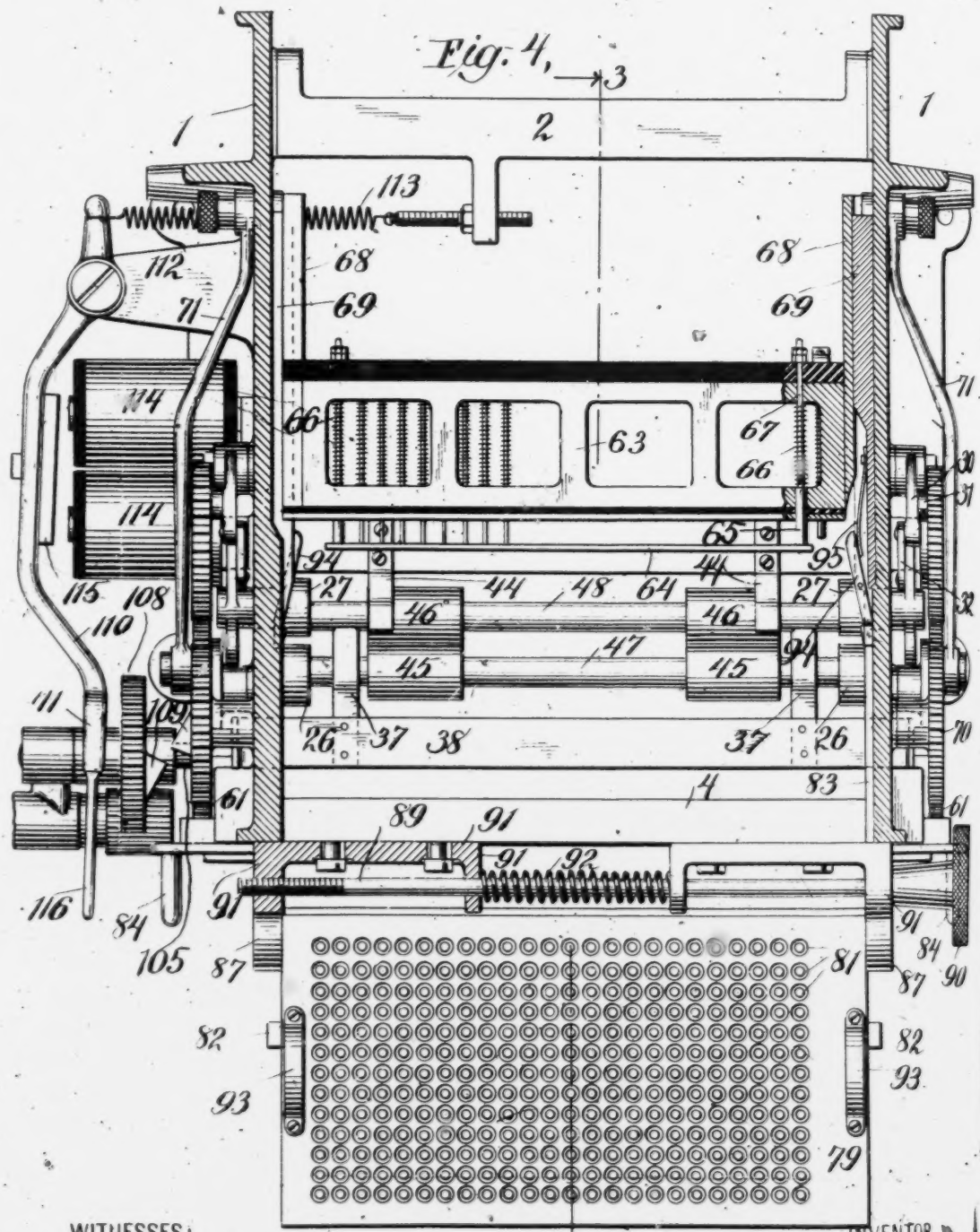
(No Model.) 12 Sheets—Sheet 4.

Fig. 4.



WITNESSES:

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(Application filed Mar. 13, 1901.)

(No Model.) 12 Sheets—Sheet 5.

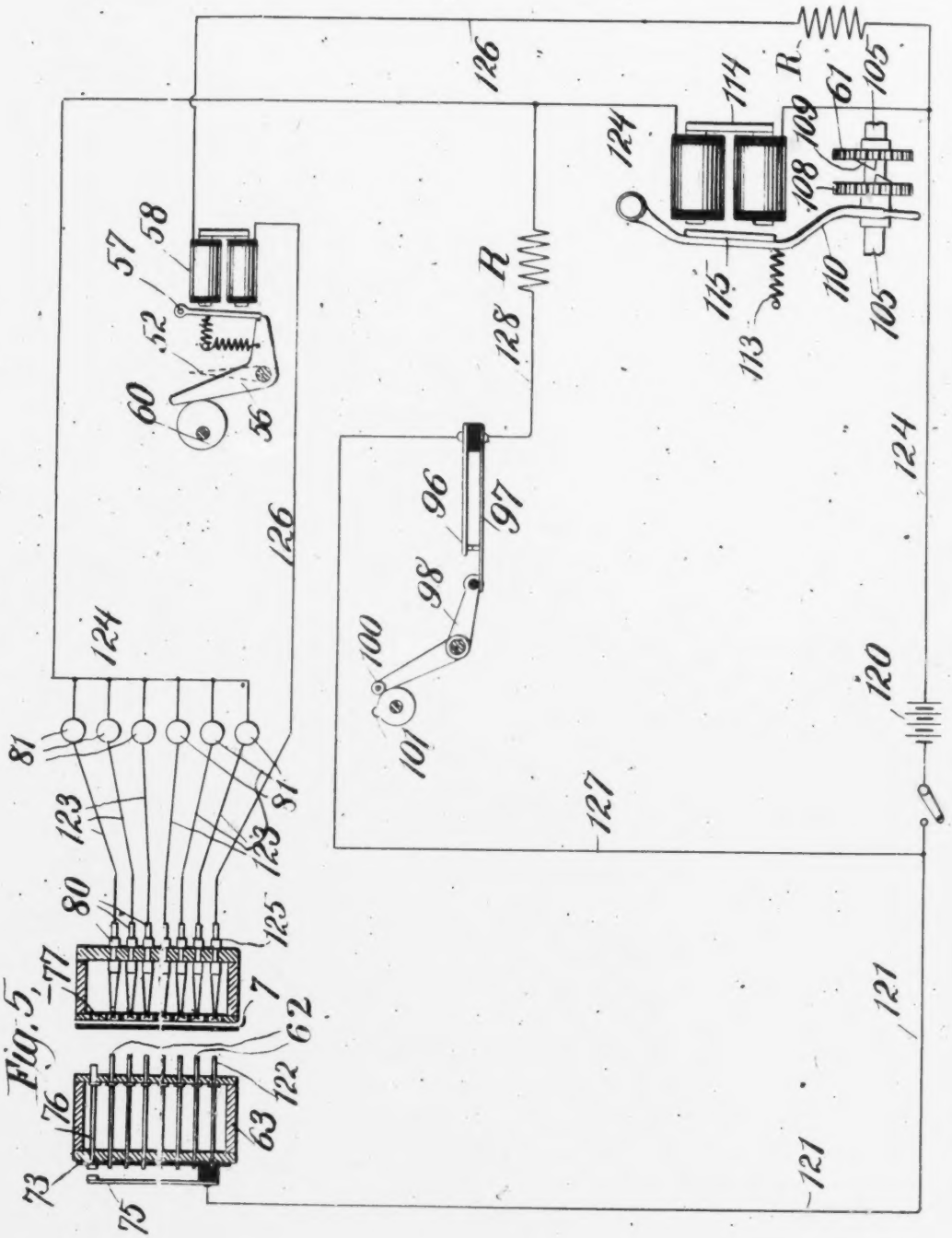

Fig. 5.

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TABULATING APPARATUS.

(Application filed Mar. 13, 1901.)

(No Model.) 12 Sheets—Sheet 6.

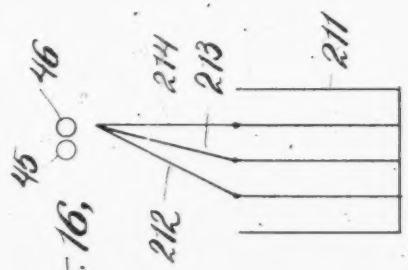

Fig. 16.

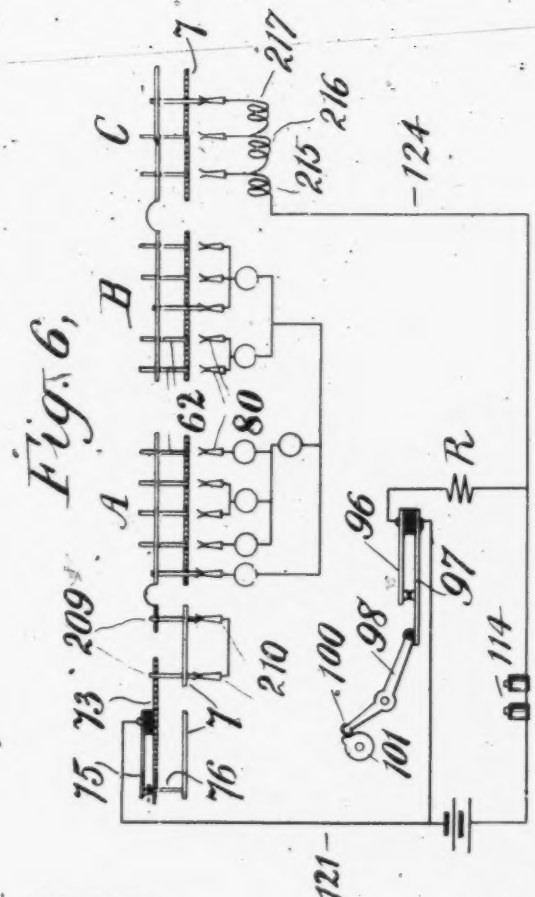

Fig. 6.

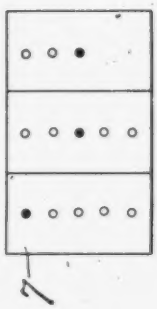

Fig. 11.

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(Application filed Mar. 13, 1901.)

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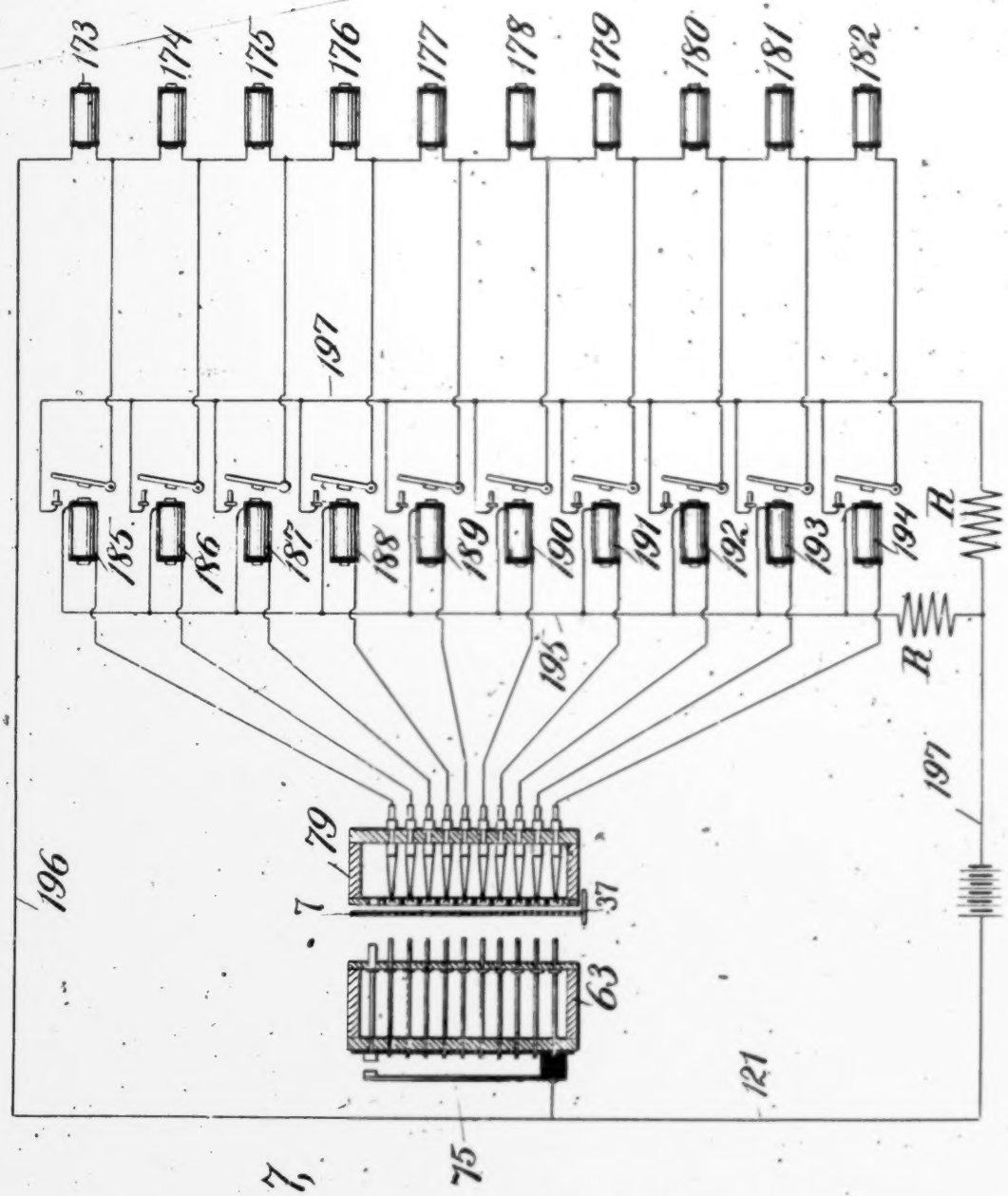

Fig. 7.

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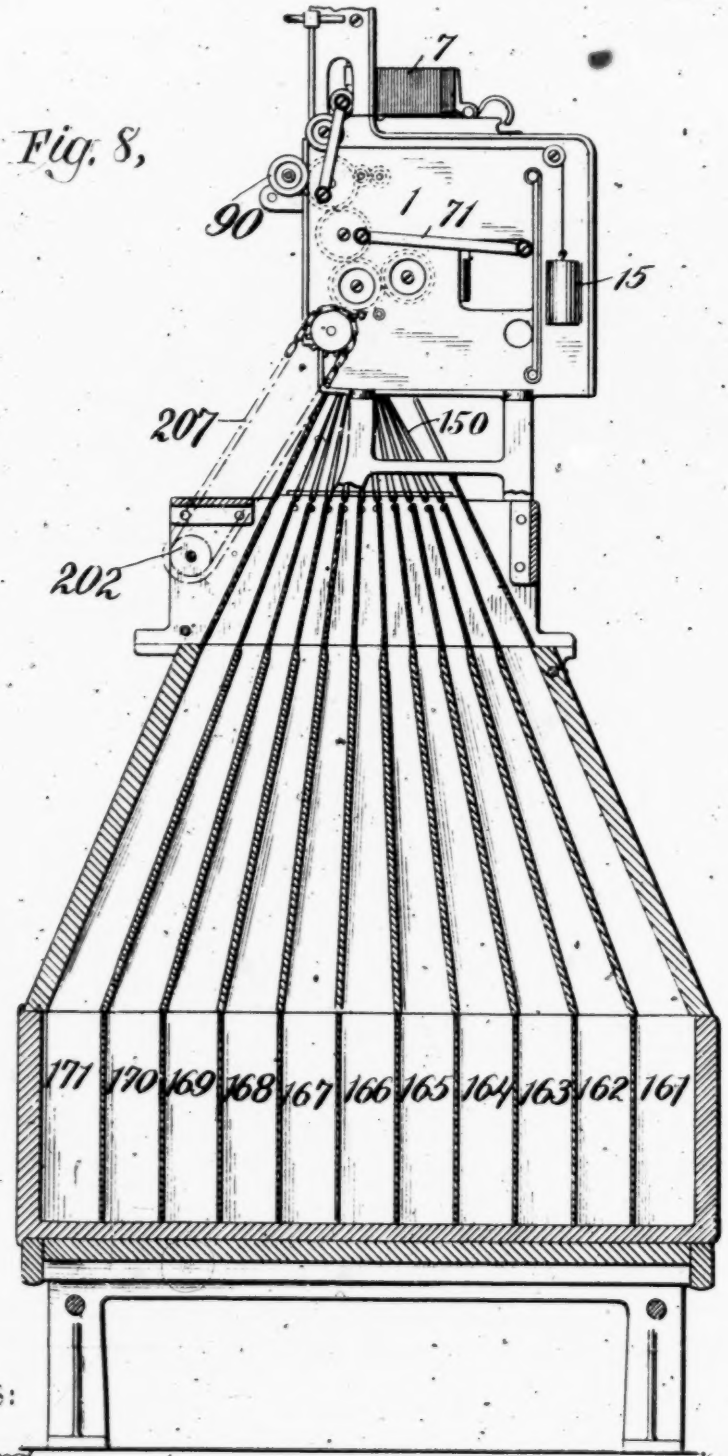
TABULATING APPARATUS.

(Application filed Mar. 13, 1901.)

(No Model.) 12 Sheets—Sheet 8.

Fig. 8,



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TABULATING APPARATUS.

(Application filed Mar. 13, 1901.)

(No Model.)

12 Sheets—Sheet 9.

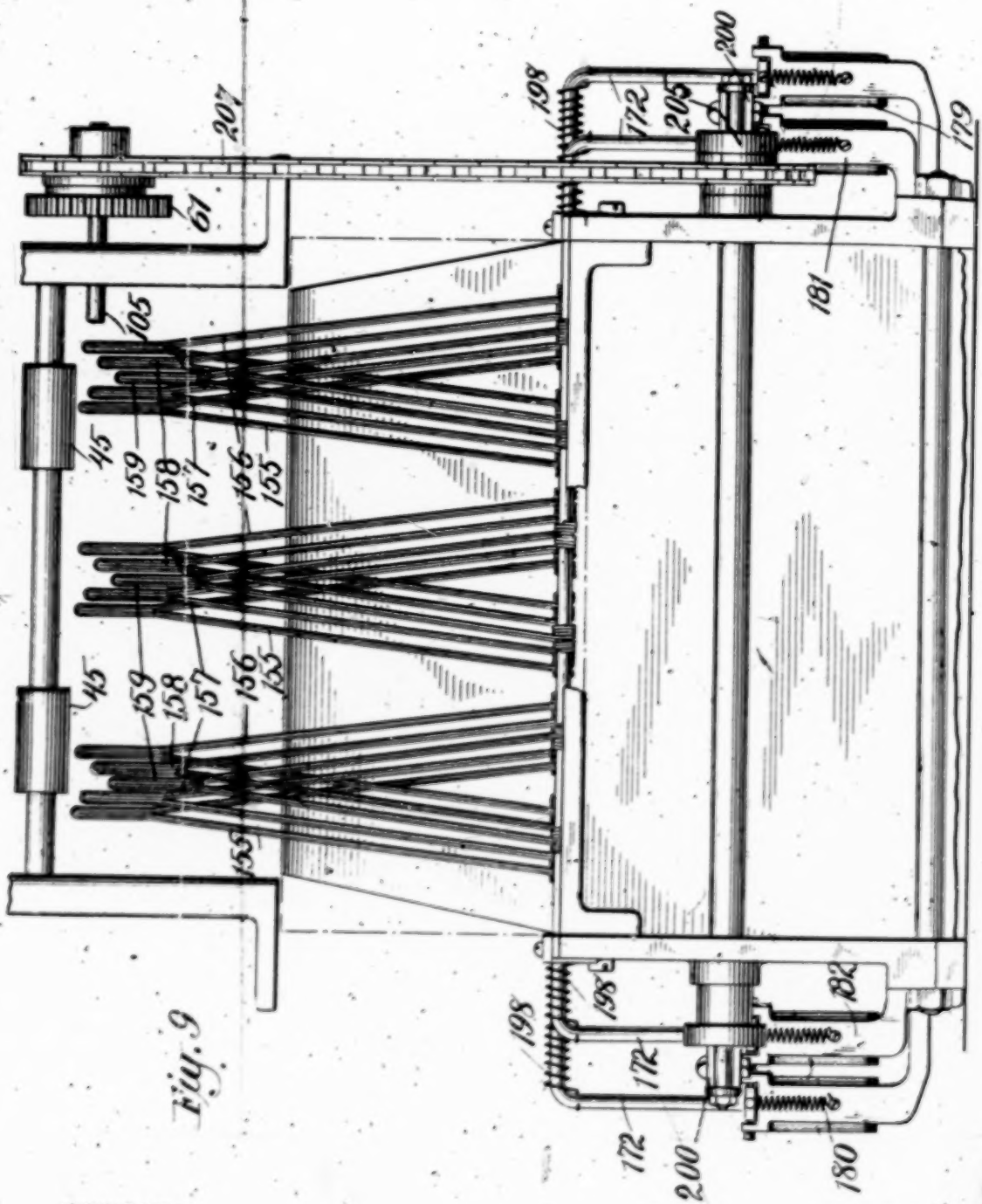

Fig. 9.

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(Application filed Mar. 13, 1901.)

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12 Sheets—Sheet 10.

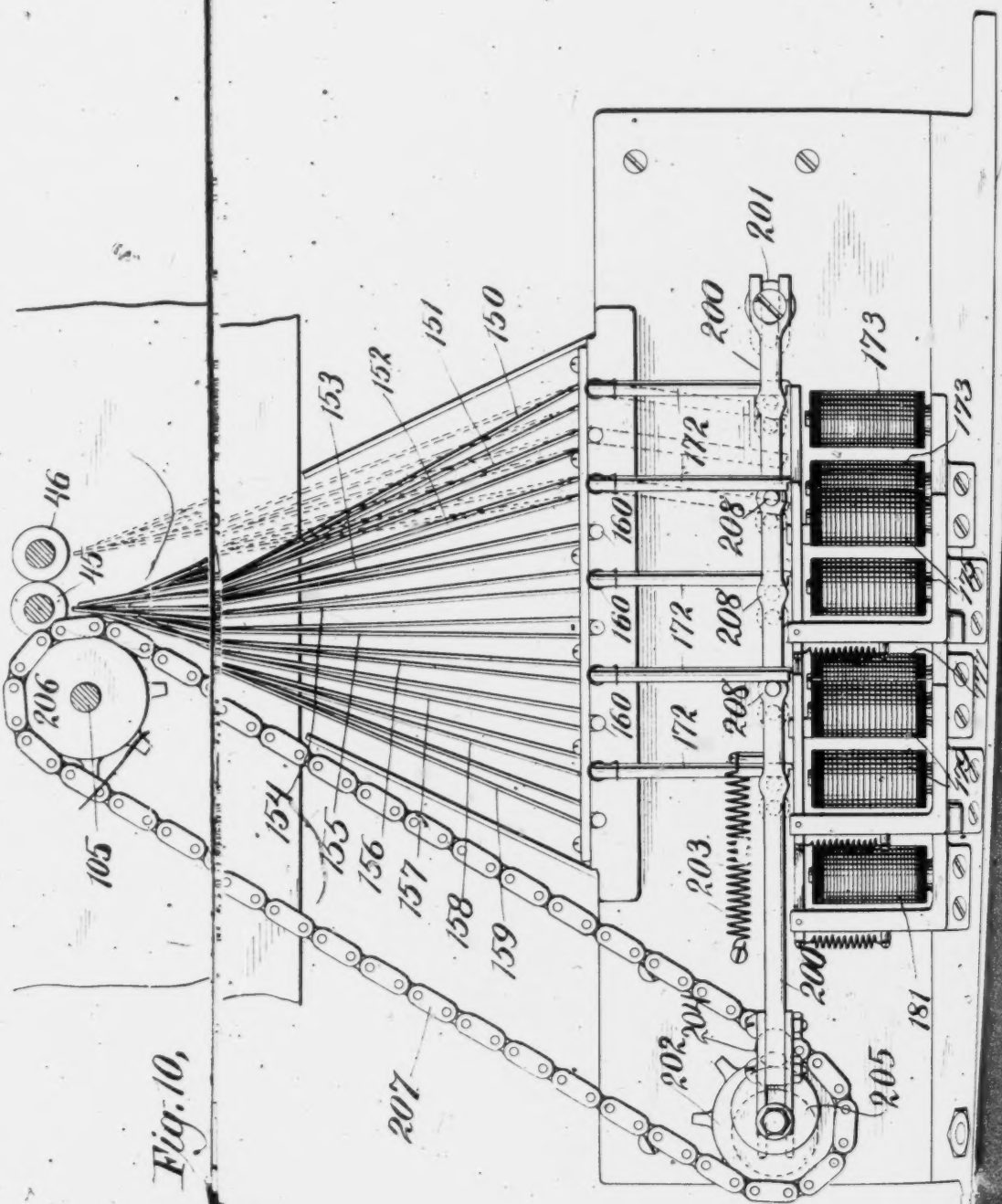

Fig. 10.

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TABULATING APPARATUS.

(Application filed Mar. 13, 1901.)

(No Model.) 12 Sheets—Sheet 11.

Fig. 12

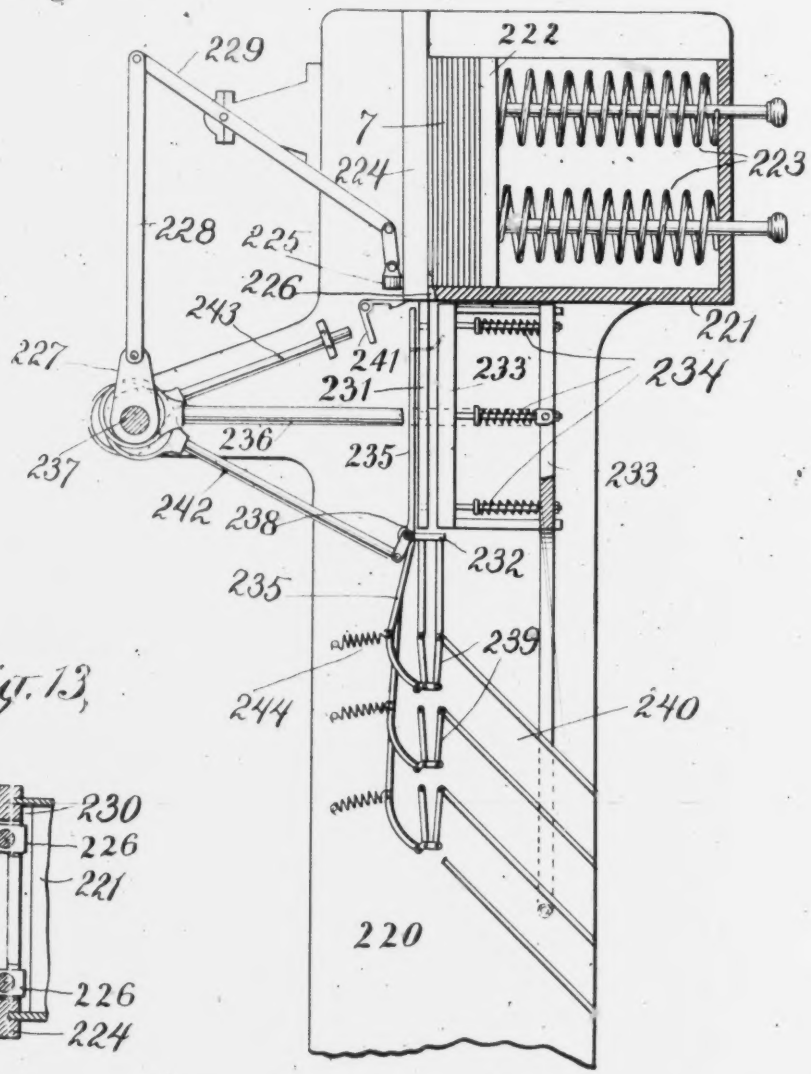
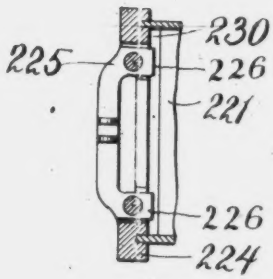


Fig. 13.



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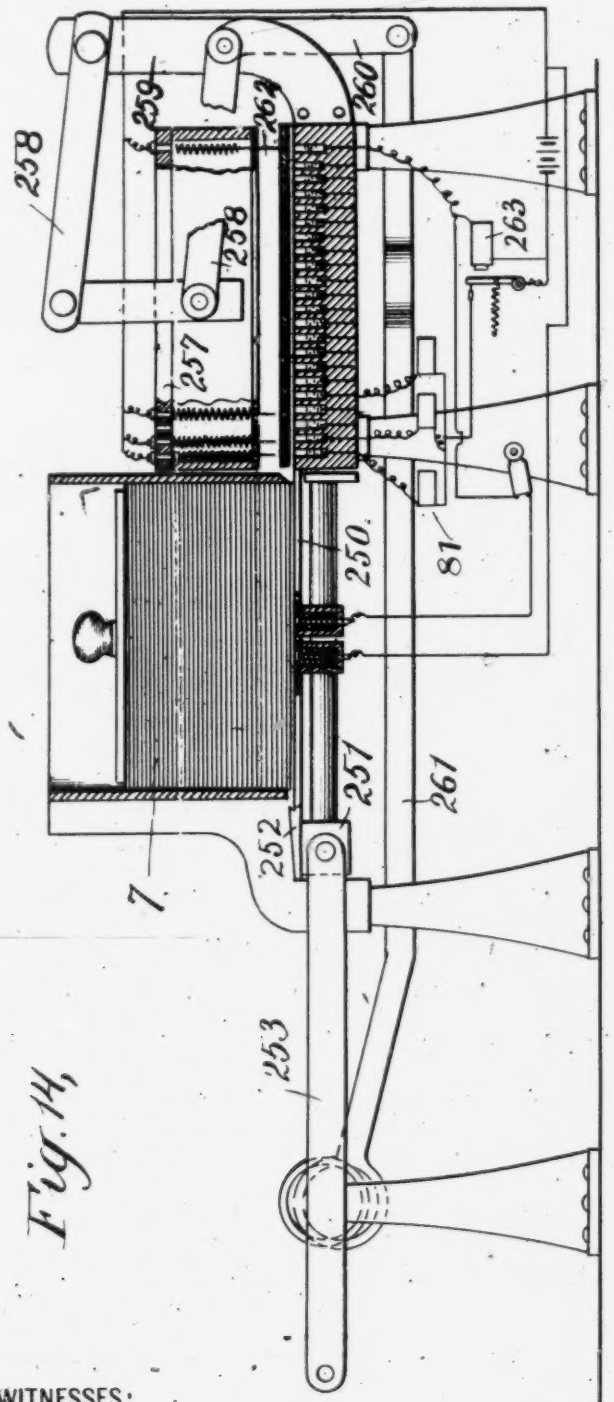

Fig. 14.

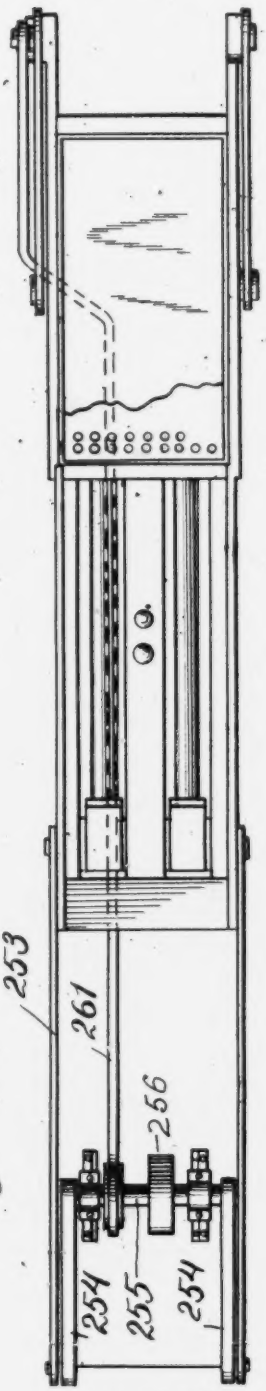

Fig. 15.

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UNITED STATES PATENT OFFICE.

HERMAN HOLLERITH, OF WASHINGTON, DISTRICT OF COLUMBIA.

TABULATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 685,608, dated October 29, 1901.

Application filed March 13, 1901. Serial No. 50,975. (No model.)

To all whom it may concern:

Be it known that I, HERMAN HOLLERITH, a citizen of the United States, and a resident of Washington, District of Columbia, have invented certain new and useful Improvements in Tabulating Apparatus, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification.

My invention relates to improvements in means and apparatus for compiling or tabulating data—such, for example, as statistical items which have been designated in or upon a suitable record.

The records consist, preferably, of separate cards in which holes have been punched, the location of each hole in the card determining the value or character of the item thus recorded. Each of these cards (whether separate or not) constitutes one record, and the items of each record are by the instrumentality of the record itself recorded upon suitable counters or registers forming part of the compiling apparatus. Stated in general terms, the principal objects of my invention are to provide means for accurately and rapidly presenting each record successively to the action of the compiling devices and to provide means whereby the records may be properly classified or sorted.

The preferred form of apparatus which I have selected for the purpose of detailed description and illustration is designed and arranged for electrical operation in connection with records which have been punched on separate cards; but it is not essential to my invention that the cards themselves should be actually separated from each other, so long as the records are presented successively to the action of the apparatus, and it will further be apparent that electrical operation is not necessary as to many features of my invention.

In the apparatus illustrated the cards, having been punched, are arranged in proper position upon a suitable feeding-platform and are thence fed one by one into their operative position, in which they control the operation of the selecting devices. The particular form of selecting devices shown consists of a series of spring-pressed conductive pins arranged to cooperate with a corresponding number of electrically-connected spring-jacks. Each card is momentarily supported in its operative position and is then carried from such position and, if desired, deposited in or upon a predetermined receiver or compartment. In the simplest form of apparatus I have described two of these receivers, but have also illustrated and described a larger number, in any one of which the card will be finally deposited according to the character of the record on the card.

Any desired number of the record-cards, within the limits of the capacity of the feeding-platform, may be placed in the machine at the beginning of its operation, and after the cards are placed in position and the apparatus started the subsequent operations, including the feeding of the cards, the compilation or tabulation of the data thereon, and the removal and sorting of the cards, are all entirely automatic and are all controlled by the records themselves.

Having thus generally indicated the principle of operation of this particular embodiment of my invention, I will now describe the accompanying drawings, in which—

Figure 1 is a side elevation of a machine designed for carrying out my invention. Fig. 2 is an elevation of the opposite side of the machine. Fig. 3 is a vertical section on the line 3 3, Fig. 4. Fig. 4 is a horizontal section on the line 4 4, Fig. 3. Fig. 5 is a diagrammatic view showing the electrical circuits and connections. Fig. 6 is a diagrammatic view showing a method of connecting the counters and their operating circuits and connections. Fig. 7 is a diagrammatic view of the circuits and connections by which a modified form of sorting mechanism is operated. Fig. 8 is a side elevation showing the machine and sorting mechanism and compartments. Fig. 9 is an end elevation. Fig. 10 is a side elevation of the sorting devices. Fig. 11 is a plan view of a record-card. Fig. 12 is a vertical section showing a modified form of feeding and sorting apparatus. Fig. 13 is a detail showing the feeding cross-head. Fig. 14 is a vertical section showing a modified form of feeding and compiling mechanism and circuits. Fig. 15 is a partial plan view thereof, and Fig. 16 is a diagrammatic view showing the sorting devices.

Similar reference characters indicate corresponding parts in all the views.

Referring to the form of apparatus shown in Figs. 1 to 6, the side frames 1 of the machine are connected by the cross-bars 2, 3, 4, and 5 and by the platform 6, which forms a support for the record-cards 7. An adjustable gage-bar 8 extends across the frame of the machine behind the platform 6 and is adjustably carried by the screws 9, by which the distance between the edge of the platform 6 and the bar 8 may be accurately adjusted, so as to leave between them a feeding-slot of the desired width to accommodate varying thicknesses of cards. A series of slats 10 are secured to the gage-bar 8 and serve to support the card and prevent its buckling. Upon the guides 11, which are carried by the cross-bars 5 and the gage-bar 8, is mounted a vertically-reciprocating cross-head 12, upon which is carried a plate 13, which projects beyond the face of the cross-head a distance slightly less than the thickness of a card. A follower-plate 14 is held against the cards by the weights 15, which are secured to the plate by the cords 16, passing over sheaves 17. The follower-plate 14 exerts a constant pressure against the cards and holds them firmly against the gage-bar 8 and the fingers 10, so that when the cross-head 12, having been lifted to the highest point, descends the plate 13 will engage the top edge of the first card and carry it down through the opening in front of the gage-bar 8. The cross-head is actuated by means of connecting-rods 18, connected to the cross-head and to the spur-gears 19. Motion is imparted to the latter in a manner to be presently described. The feed-rolls 20 21 extend across the machine, just below the feeding-slot, between the gage-bar 8 and the platform 6. The rolls are provided with intermeshing gears 22, and pinions 23 on the roll 20 mesh with the gears 19, by which the rolls are driven. The roll 20 is journaled in the side frames of the machine, and the roll 21 is mounted on the ends of the pivoted arms 24, to the opposite ends of which are secured the springs 25, which hold the roll 21 in yielding contact with the roll 20, thus allowing for any variation in the thickness of the record-cards. On each side of the machine, below the feeding-rolls, are mounted two stud-rolls 26 27, which are driven at a higher speed than the feed-rolls and which I therefore term "accelerator-rolls." The rolls 26 are journaled in the side plates of the machine; but the rolls 27 are each mounted in a rock-arm 28, carried by the shaft 29, upon which the spur-gears 30 are mounted. The rock-arms 28 are secured to the pivoted arms 31 by the links 32, and springs 33 are secured at one end to said arms and at the other end to the side frames of the machine. Antifriction-rollers 34, carried by the arms 31, are engaged by cams 35 on the shaft 29. The rotation of the shaft 29 will thus rock the arms 28, so as to carry the rolls 27 toward and away from the rolls 26 at each revolution of the shaft 29, the parts being so proportioned and arranged that during the feeding of a card into operative position and during the time that the mechanism is under the control of the card the rolls 27 will be held away from the card; but when such control is completed the rolls 27, which are positively driven at all times by the pinions 36, in mesh with the gears 30, will be carried into engagement with the edges of the card and will feed it down into the ejector-rolls, to be presently described.

Each card is supported in position to control the operation of the circuit-closing devices (the pins and jacks above referred to) by fingers 37, carried by the reciprocating bar 38, which are moved into position under the card before the latter reaches its operative position and which are moved out from under the card as soon as the action of the circuit-closing devices is completed. The bar 38 projects through slots 39 in each side plate of the machine. The ends of the bar 38 are carried upwardly and at their extremities carry studs or rollers 40, which are engaged by cams 41 on the spur-gears 42. Springs 43 hold the rollers 40 in engagement with the cams 41, so that the bar 38 and fingers 37 will be moved back and forth at each revolution of the gears 42. Stationary fingers 44, secured to the cross-bar 3, project toward the fingers 37, and when the latter have been advanced into their supporting position the two sets of fingers will extend completely across the path of the movement of the cards and prevent them from dropping below their operative position until the supporting-fingers 37 are withdrawn.

The ejector-rolls 45 and 46 are mounted on the shafts 47 and 48. The shaft 47 is journaled in the side plates of the machine, and secured to the shaft are the pinions 49, which mesh with the gears 42. The shaft 48 is journaled in the arms 50, pivoted to the side frames of the machine, and to the lower ends of the arms are secured the springs 51, whereby the rollers 46 are held toward the rollers 45 and exert a yielding pressure against the cards which are fed between them. The rolls 45 are positively driven, preferably at a higher rate of speed than the accelerator-rolls, by the pinions 49, and the rolls 46 are driven frictionally.

The sorting mechanism comprises a suitable number of receivers into which the records are delivered. For convenience of description I have used the term "sorting-compartments" in referring to these receivers, and I employ this term broadly and without any literal limitation, intending that it shall cover any suitable receptacle or device for receiving the cards, so as to preserve the classification or separation of the records effected by the machine. In the form of apparatus shown one or more guides or deflec-

tors are employed, which are arranged and operated to deliver each card into one of two or more sorting-compartments. In the simplest form, Figs. 3 and 5, the deflector 52 is arranged to deliver the cards into either one of the two chutes or compartments 53 or 54. The deflector 52 is secured to the rock-shaft 55, upon one end of which, outside the frame, is secured a bell-crank 56, normally latched in the position shown in Fig. 2 by the armature 57 of an electromagnet 58. With the bell-crank in this position the deflector will be in the position shown in full lines in Fig. 3, and any card passing through the ejector-rolls will be delivered into the chute 53. If, however, a circuit be established through the coils of the magnet 58, the armature 57 will be attracted, releasing the bell-crank 56, the opposite arm of which under the action of spring 59 will be carried against the revolving cam 60, carried by the gear 61, which meshes with the gear 42. This will swing the deflector 52 into the position shown in dotted lines, Fig. 3, establishing communication between the ejector-rolls and the chute 54. The cam 60 is so adjusted that at the time of the completion of the circuit through the magnet 58 the minor radius of the cam will be toward the lever 56, and the revolution of the gear 61, which will bring the major radius of the cam under the arm of the lever 56, will carry said lever and the deflector back into their normal position, when the lever will be automatically relatched by the armature 57.

The sorting mechanism shown in Figs. 7 to 10 comprises means for establishing communication between the ejector-rolls and any one of eleven sorting-compartments; but it is in principle substantially the same as that just described, and I will therefore describe the other mechanical and electrical features of the apparatus before proceeding to a detailed description of such sorting mechanism, it being understood, of course, that as many different compartments may be employed as the character of the records being tabulated may render desirable.

The selecting or circuit-closing devices to which I have previously referred and which coöperate with the record to operate the compiling or sorting mechanism, and also, as shown, to control the operation of the machine itself, comprise a suitable number of spring-pressed conductive-pins 62, carried in a frame or pin-box 63. The pins project normally beyond the face of the pin-box, which carries a yielding pressure-plate 64, provided with apertures through which the ends of the pins may pass. The pressure-plate 64 is supported at its corners on guides 65, Fig. 4, which enter suitable apertures in the pin-box, and the plate is held away from the face of the pin-box by springs 66, carried by the posts 67, on which the guides 65 travel. Secured to each end of the pin-box 63 is a horizontally-extending arm 68. These arms are channeled to embrace the guides 69 on the side plates of the machine and are connected with the gears 70, which mesh with the gears 19 and 42, by the connecting-rods 71. Suitable openings 72 are formed in the side plates of the machine to permit the pin-box to be reciprocated when the gears 70 are rotated. The pins 62 in the particular system of electrical connection to be herein described are primarily all insulated electrically from each other; but they are arranged in groups in accordance with the data to be tabulated, and the pins of each group are connected by an electrical conductor common to all the pins of the group, as indicated in Fig. 5, in which the pins 62 are represented as belonging to one group having the common electrical conductor 73. The pins of the other groups are similarly connected with each other, the connections between the groups being more fully described hereinafter. A contact device controlled by the record is carried by the pin-box for establishing an electrical connection between the pins in one of the groups and the generator. This device comprises a conducting-tongue 75, connected with the circuit. A spring-pressed contact-pin 76 is carried by the pin-box in such position that when a record is properly positioned to coöperate with the selecting devices the pin will as the pin-box is reciprocating engage with the card, its forward movement will be arrested, and the continued movement of the pin-box will cause the pin 76, which is in contact with the conductor 73, to contact with the tongue 75. If, however, no card is in position in front of the pin-box, the pin 76 will enter a hole 77 in the plate 78 of the jack-box or frame 79 and will not contact with the tongue 75, and the circuit will remain open at this point.

The jack-box 79 carries a number of spring-jacks 80, one for each of the conductive pins in the pin-box. The jacks 80 are insulated from each other, and each one of them is connected by conducting-wires with the magnet-coils of an electromechanical registering device 81. In case the compilation consists in the classification and counting of units of varying character—as is the case, for instance, in tabulating certain statistics of population—the registering devices may consist of any form of ordinary electrically-operated unit-counting devices; but in case the work comprises the registering or addition of items of varying amounts, the registering devices shown and described in my pending application, Serial No. 24,019, may be employed instead of such counters. By the term "compiling" apparatus as herein used I intend to include these and other equivalent registering or counting devices.

The spring-jacks are so arranged that each time the pin-box is reciprocated (if no card be in position in front of the jacks) each of the conductive pins carried by the pin-box will contact with its corresponding jack; but if a card properly punched be in position those pins which are opposite the perfora-

tions will pass through the perforations and contact with the jacks, while those pins opposite the spaces on the card which have not been punched will be held back by the card and will not contact with the jacks. At each end of the jack-box is a projecting rib 82, which enters a groove 83, formed in the side frames of the machine. These serve to support the jack-box in position, and when in position it is firmly clamped in place by the latches 84, pivoted to the frame of the machine and which may be swung inwardly behind the jack-box. The jack-box is also provided on each end with a projecting stud 85, (shown in dotted lines in Fig. 3,) which enter grooves 86 in the side frames. These grooves are extended into the adjustable brackets 87 and terminate in the circular aperture 88. The brackets 87 are secured to the cross-bar 4 so as to permit a limited movement toward and from each other. A rod 89, provided with a suitable adjusting-head 90, passes through holes formed in lugs 91 on the brackets, the end of the rod and its corresponding lug being screw-threaded. A closed coil-spring 92 is carried by the rod and presses against the inner lug on each bracket and tends to separate the brackets. By turning the rod 89 to the right the brackets 87 will be drawn toward each other by the clamping action of the adjusting-rod. By turning it in the opposite direction the brackets will be relieved of the clamping action of the rod and the spring 92 will force them away from each other. When, therefore, it is desired to remove the jack-box from its normal position in the machine, the latches 84 are swung out from behind the jack-box, and by the handles 93 it is drawn outwardly, the studs 85 sliding in the grooves 86 until they enter the apertures 88. The jack-box will then be entirely outside of the machine and may be swung on the pivots formed by the studs 85, as indicated in Fig. 4. By tightening the rod 89 the brackets 87 will be drawn together and will engage and firmly clamp the jack-box, which may thus be adjusted and held at any desired angle.

A centering-finger 94 is pivoted to each side frame of the machine in the groove 83. The ends of these fingers nearest the pin-box are pressed inwardly by the springs 95 into the path of the pin-box. The opposite end of each of the fingers is provided with a card-engaging shoulder which is exactly in line with the cards as they are fed into operative position in front of the jack-box. When the pin-box is moved toward the jack-box, the inwardly-pressed ends of the fingers 94 will be engaged by the ends of the pin-box and pressed back toward the frame of the machine, thus swinging the shouldered ends inwardly, so that as the pressure-plate 64 is about to engage with the card the distance between the inner sides of the shoulders on the fingers will exactly equal the length of the card. If therefore a card has been fed either to one side or the other of the correct position, it will be moved longitudinally by the finger into the path of which it may project until the opposite end of the card contacts with the opposite finger, when the perforations on the card will register exactly with the proper openings in the pressure-plate, in which position it is then engaged and held securely by the pressure-plate during the operation of the circuit-closing or selecting devices.

Secured to one of the side frames of the machine and insulated therefrom is the contact-bar 96, provided with an adjustable contact-screw, with which the spring-tongue 97 is normally in contact. A bell-crank 98 is pivoted to the frame of the machine, and an insulated stud or roller 99, carried by one of its arms, normally rests on the spring-tongue 97. A stud or roller 100 on the end of the other arm of the bell-crank lies in the path of the cam 101 on the gear 61, and as the cam is revolved it will engage with the stud 100, lifting that end of the bell-crank, depressing the opposite end, and breaking the contact between the tongue 97 and contact-screw on the bar 96. As soon as the cam has passed the stud 100 the tongue 97 will reëstablish the contact with the screw.

The gears 61 are carried by the operating-shaft 105 of the machine, and the gears 19, 30, 42, and 70 are of the same size as the gear 61, so that when said shaft is thrown into operative connection with the motor by which the machine is operated one revolution of the operating-shaft will produce one reciprocation of the pin-box and one reciprocation of the card feeding and supporting devices. The operating-motor (which may be of any character) is connected with the power-shaft 106, carrying the pinion 107, which meshes with the gear 108, splined to the shaft 105. One of the gears 61 and the gear 108 are provided with shoulders 109, which are adapted to interlock and form a clutch between the two gears when they are brought together. This engagement is effected by means of the clutch-lever 110, which is formed with a yoke 111, which enters a groove in the hub of the gear 108. At its opposite end the lever 110 is pivotally supported by a lug 112, formed on the frame of the machine, and an adjustable tension-spring 113 normally holds the gears 61 and 108 apart, so that the shoulders 109 will not engage with each other when the gear 108 is revolved. An electromagnet 114 is supported on the frame of the machine and its armature 115 is carried by the clutch-lever 110. When the coils of the magnet 114 are energized, the armature 115 will be attracted by the magnet and the lever 110 will be drawn inwardly, sliding the gear 108 toward the gear 61. The shoulders 109 will thus engage, and the motion of the gear 108 will be transmitted to the gear 61 and to the other actuating-gears of the machine, the operation of which will thus be commenced and continued until the armature 115 is released by the breaking of the

circuit through the coils of the magnet 114, when the spring 113 will actuate the lever 110 to disconnect the gears 61 and 108, and the machine will stop. A handle 116 is formed on the clutch-lever 110, by which the starting of the machine may be assisted manually in case of sluggish action of the magnet 114.

Referring now to the diagram, Fig. 5, of the electrical circuits, the contact-tongue 75 is connected with the generator 120 by the conductor 121. For simplicity only one group of conductive pins 62 and jacks 80 is shown in this diagram, the connection of which with the terminal 75 is controlled by the contact actuating-pin 76, as previously described. The conductive pin 122 is in electrical connection with the pins 62. Each of the spring-jacks 80 is connected with the magnet of one of the registering devices or counters 81 by the conductors 123. A conductor 124, which includes the coils of the starting-magnet 114, connects all the counters with the generator. The pin 122, which controls the operation of the sorting apparatus, coöperates with the jack 125, which is connected with the line by a conductor 126, which includes the coils of the sorting-magnet 58. This magnet controls the position of the deflector 52. When its coils are inactive, the bell-crank 56 will hold the deflector 52 in position to deliver the cards into the chute 53. When a circuit is completed through the coils, the bell-crank 56 will be released and swing the deflector into the position shown in the dotted lines, Fig. 3, and the card will be delivered into the chute 54. These circuits are, as will be readily understood, open a tall times except when one of the conductive pins is in contact with one of the jacks and are therefore directly controlled by the record, and I have hereinafter employed the term "record-controlled" to designate one or both of these circuits. The contact between the pins and jacks in the regular operation of the machine exists only during a fractional part of one revolution, and as the specific form of machine which I have been describing is intended for continuous electrical operation it is necessary to provide an independent circuit by which the circuit through the clutch-magnet 114 shall be closed during the remainder of the revolution. This circuit, which I have termed the "starting-circuit," comprises the conductor 127, connecting the contact-bar 96 with the conductor 121, and the conductor 128, connecting the spring contact-tongue 97 with the conductor 124. This circuit is normally closed; but once in each revolution of the machine the cam 101 will engage the stud 100 and actuate the bell-crank 98 to momentarily break the contact between the tongue 97 and the bar 96, as previously explained, and the operative parts of the machine are so arranged that this will occur when the circuit is completed through the pin-box. Thus I provide not only for the continuous rotation of the machine but control of the machine is transferred entirely to the circuit-closing devices controlled by the record, so that unless the circuit is completed through them, which will not occur unless a properly-punched card is in proper position in the machine, the clutch-magnet 114 will be deënergized, releasing the clutch 110, and the machine will stop. Suitable resistances R are arranged in the circuits to properly balance them.

In making a more extensive subdivision of the cards (which, of course, may be done independently of the compilation) by sorting them into more than two classes I may employ an additional deflector for each additional sorting-compartment or I may employ one variably-operated guide or deflector for all the compartments. In Figs. 7 to 10 I have shown a plurality of deflectors. These are operated by magnets controlled by pins in the pin-box, and an additional pin, jack, and magnet are employed for each additional deflector. The principle of operation is the same whether two or a greater number of compartments and whether one or a plurality of deflectors be employed; but in Figs. 7 to 10 I illustrate a modified arrangement of electrical operating means, which I will now describe. The deflectors 150 to 159 are mounted below the ejector-rolls 45 46 on rock-shafts 160, which are arranged at the top of chutes leading to the compartments 161 to 171 of the sorting-box. Each rock-shaft is provided with a depending arm 172. Five of these are on one side of the machine and five are on the other side, arranged alternately. A series of electromagnets 173 to 182 are arranged below these arms. The armature of each of these magnets engages and latches one of the arms 172 in the position shown in Figs. 8 and 10. In this position all cards delivered from the machine will pass into the compartment 161. Referring to Fig. 7, each of the magnets 173 to 182 is in a separate circuit and each of these circuits is controlled by one of the relays 185 to 194. Each relay is connected with one of the jacks in the frame 79 and through a suitable resistance R with the generator. The pins which coöperate with the jacks to actuate the relays are adapted to be connected with the generator by conductor 121, as previously described, when the pin-box 63 is operated. The delivery of the card into its proper compartment is determined by punching a hole therein, which when the card is in position will be opposite the jack which is connected with the proper relay. If the record on the card denotes, among other things, that the card should be delivered into the compartment 164, a hole is punched in the card opposite the jack connected with relay 187. When the pin contacts with this jack, the circuit will be closed and established through the relay 187, which is connected with the generator by the conductor 195. The relay-mag-

starting from the generator, includes conductors 121 and 196, the coils of magnets 173, 174, and 175, the contacts of relay 187, the conductor 197, the resistance R. The closing of the circuit through the coils of the magnets 173, 174, and 175 will cause these magnets to attract their armatures and release the arms 172, connected with the deflectors 150 151 152. Torsion-springs 198 on the shafts 160 will cause these three deflectors to swing to the right, Fig. 10, past the ejector-rolls, establishing communication with the receptacle 164, into which the card delivered by the machine will fall by gravity. On each side of the machine is a reciprocating bar 200. These bars are each supported at one end on a guide 201 and at the other by the shaft of the sprocket-wheel 202. A spring 203 holds a stud 204, carried by each bar, in contact with a cam 205 on the sprocket. The sprocket 202 is driven by the sprocket 206, with which it is connected by the chain 207. The sprocket 206 is carried by the shaft 105. At each revolution of the sprocket 202 the bar 200 under action of the spring 203 and cam 205 is moved back and forth to and from the full-line to the dotted-line position shown in Fig. 10. The machine is so timed that just before the arms 172 are tripped by the magnets the studs 208 will have been moved out of engagement with the arms, so as to permit the deflectors to reach their limit of movement to the right, Fig. 10, when the bar 200 is retracted to the dotted-line position. After the card has been delivered into the proper compartment and after the relay-circuit has been broken through its pin and jack and the sorting-magnets have been deënergized the revolution of the cam 202 will advance the bar 200 and the studs 208 will carry the arms 172 forward into engagement with the armatures, where they will be relatched. The deflectors will thus be all returned to their normal position and all cards not properly punched for delivery into one of the receptacles 162 to 171 or to close the circuit through the pin-box will fall into the receptacle 161.

Referring to the sorting mechanism, I have for convenience of description referred to the device employed for establishing communication with the proper compartment as a "deflector." It is not necessary to the operation of my invention that the cards should be actually deflected into the proper compartments, and I do not intend to limit any of my claims to a structure in which the part 52 or its equivalent actually engages with or deflects the cards.

In the diagram Fig. 6 I have illustrated more in detail one of the many possible ways of connecting the pins, jacks, and counters. In this diagram I have indicated a card 7 in position in front of the jacks. Certain of the pins are in contact with the jacks, having passed through the holes in the card. The other pins are held back out of contact with the jacks. I have also shown two pins 209 and jacks 210, which are located just outside of the margin of the card when it is in proper position before the jacks. Any practicable number of these pins may be employed, and they are so located that if a card is not fed into proper operative position the card will project over the pins, hold the pins back, and prevent them from making contact. As these pins are connected in series in the record-controlled circuit, such failure to establish contact will prevent any action of the devices in circuit with them and stop the machinery by releasing the clutch-lever 110. The pins 62 and their jacks 80 are arranged in groups, of which three are shown. Groups A and B each represent a different series of statistical items according to the scheme of compilation. The jacks are also arranged in subgroups according to the scheme of counting. For instance, the first, second, and fifth jacks of group A control separate counters, while the third and fourth jacks are provided with a counter common to both, and the second, third, fourth, and fifth jacks are provided with a total-counter, which will totalize their registration. The connection of the other counters will be readily understood from the diagram in view of the above explanation. Group C comprises the pins and jacks which control the sorting apparatus. (Shown diagrammatically in Fig. 16.) The diagram Fig. 6 illustrates another of the many possible ways of connecting and operating the sorting apparatus. As shown in this diagram and in Fig. 16, the apparatus comprises a receiver 211, containing four compartments. Three deflectors 212 to 214 are arranged to control communication with these compartments. The deflectors are held in position by latches controlled by electromagnets. When the magnets are energized to release the latches, springs actuate the released deflectors to establish communication with the proper compartment, and after the record has been delivered resetting mechanism returns the deflectors to their normal position, where they are engaged and held by the latches. The deflectors are operated substantially as shown in Fig. 10, except that the deflector-magnets 215, 216, and 217 are connected in series with each other in the circuit established through the pin-box instead of being controlled by relays, so that if the circuit is not properly closed through the pin-box, owing to an improperly punched or located card, none of the deflectors will be actuated and all such defective cards will fall into the left-hand compartment of the receiver 211. If, however, the card be properly punched to effect the closing of the circuit through one of the pins of group C, one or more of the magnets will be energized, depending upon which pin is included in the circuit, and a corresponding number of deflectors will be operated to deliver the record to the predetermined compartment.

The operation of the machine is as follows: The cards 7, having been punched, are placed upon the platform 6, and the follower-plate 14 is placed behind them. The switch is then operated to close the circuit through the conductors 121 and 127, contacts 96 and 97, conductor 128, clutch-magnet 114, and conductor 124. This locks the gear 61 with the gear 108 and starts the machine. The cross-head 12 descends, and the blade 13 will engage with the upper edges of the first card on the platform and will carry it down until it is grasped by the rotating rolls 20 and 21, which will feed the card downward until it rests on the supporting-fingers 37 and 44. In the meantime the pin-box has been reciprocated toward the jack-frame, and as soon as the card has been adjusted longitudinally by the centering-fingers 94 the yielding pressure-plate 64 will engage with the card and hold it firmly against the plate 78. As the pin-box advances the pins 62 will be projected through the holes in the pressure-plate and will contact with the card where there are no holes punched. Such of the pins as are opposite holes in the card will, however, enter them and contact with the jaws of their spring-jacks. As this occurs the pin 76 will contact with the card and will be held back as the pin-box advances, contacting with the tongue 75 and closing the record-controlled circuit through conductor 121, contact 75, pins, jacks, and counters, conductor 124, and clutch-magnet 114. As soon as this circuit is established the cam 101 will actuate the bell-crank 98 and break the starting-circuit momentarily. Referring to the diagram Fig. 6 and assuming that the card now in position has been punched, as indicated in Fig. 11, in which the first circle in group A, the third in group B, and the third in group C have been punched, the circuits will be established as follows: from the contact 75 to the conductor 73, through the pins 209 and jacks 210 to the pins of group A, by the first pin of that group to the jack, through the magnet-coils of the left-hand counter connected therewith to the right-hand counter of group B, to the third jack and the pin in contact therewith, to the conductor connecting all the pins of the group, thence to the conductor common to all the pins of group C, thence by the third pin to the third jack, and through the coils of the sorting-magnets 215, 216, and 217, releasing all three of the deflectors 212, 213, and 214, which will swing to the left and establish communication with the right-hand compartment of the receiver 211. From the sorting-magnets the circuit will be completed by conductor 124 to the clutch-magnet coils and thence to the generator. From this diagram and description it will be readily seen that if the card is not in position to engage the pin 76 or is not in position to escape the pins 209 or if no hole is punched in any group the circuit will not be completed through the pin-box, and when the starting-circuit is broken between the contacts 96 and 97 the machine will stop. After the circuit has been established as above the pin-box is drawn back from the jacks, and as soon as the pressure-plate 64 is carried out of contact with the card the rolls 27 are swung toward the rolls 26, engaging the ends of the card. At the same time the supporting-fingers 37 will be drawn from under the card, which will be fed between the ejector-rolls 45 and 46 and delivered into the proper sorting-compartment, and the deflectors will be reset, as before described. If, however, the circuit is not completed, owing to a defective card, none of the deflectors will be operated and the card will be delivered into the compartment for rejected cards. Another card will in the meantime have been fed into position and the operation above described will be repeated continuously until the machine is stopped, as above described, by the improper registration or punching of a card or by the exhaustion of the supply on the feeding-platform.

I have said that electrical operation is not essential to many of the features of my invention. For instance, the sorting apparatus may be operated mechanically, if desired, and in Figs. 12 and 13 of the drawings I show a modified structure embodying such a mechanically-operated sorting apparatus. This consists of the side frames 220, which support the card-platform 221. The follower-plate 222 under the action of the springs 223 holds the cards 7 firmly against the slotted plate 224, in which the cross-head 225 reciprocates. The cross-head is provided with projecting lips 226, which engage with the upper edges of the cards, and is reciprocated by the crank 227, with which it is connected by the connecting-rod 228 and lever 229. Between the card-platform 221 and the plate 224 is a slot 230, through which the cards are fed by the cross-head. Below this slot is a perforated plate 231, at the bottom of which is the card-support 232. The pin-box 233 carries a number of spring-pressed pins 234, arranged to enter the perforations in the plate 231. Behind the plate 231 is a series of pivoted fingers 235, one for each of the sorting-compartments. When the pin-box is reciprocated by means of the connecting-rods 236, which are connected with the crank-shaft 237 by a suitable eccentric, the pins will, if no card is in position, enter their respective holes in the plate 231 and engaging with the fingers 235 will press them away from the plate. The fingers 235 are extended downwardly below their fulcrums 238, forming levers, each of which is connected with a hinged deflector 239. Each deflector consists of two pairs of pivoted links, one pair being arranged near each end of the card. If a card be punched for delivery into one of the compartments 240, when the card is in position and the pin-box is reciprocated the proper pin will pass through the hole in the card and swing the finger which controls the deflector

communicating with that compartment outwardly, where it will be engaged by the latch 241. This will swing the deflector in toward the sorting-compartment and will establish communication therewith. When the support 232, which is connected with the shaft 237 by the connecting-rod 242, is swung downwardly by the rotation of the shaft, the card will be released and will fall into the proper compartment. After this occurs the rotation of the shaft 237 will carry the rod 243 into engagement with the latch 241, lifting it and releasing the finger, which will return to its original position under the action of the spring 244.

In Figs. 14 and 15 of the drawings I illustrate a modified form of apparatus in which the cards are supported and fed to the circuit-closing devices horizontally instead of vertically. The cards 7 are supported on the platform 250 and are fed into position under the pins by the horizontally-reciprocating cross-head 251, to which a plate 252 is secured. This plate is provided with a projecting edge which engages the under card in the pile. The cross-head is by the connecting-rods 253 connected with the cranks 254, secured to the shaft 255, upon which the driving-pulley 256 is mounted. This pulley receives power from any suitable source. The pin-box 257 is supported by two pairs of links 258, which are at one end pivoted to the upright 259, secured to the frame of the machine, and at the opposite end are pivotally secured to the pin-box. One pair of the links 258 is connected with the lever 260, and the lower end of this lever is connected with an eccentric on the shaft 255 by the connecting-rod 261. The parts are so arranged that when the shaft 255 is rotated the cross-head 251 will be reciprocated to feed a card into position under the pins, and then the lever 260 will be swung outwardly to depress the pin-box. In this form of apparatus I have dispensed with the spring-jacks and have substituted for them a series of mercury-cups, one for each pin. The pins are electrically connected with the line by a common conductor, and each of the cups is separately connected with one of the registering devices 81. In Fig. 14 I also illustrate a modified form of device for preventing any registration in case no card is in the machine. This consists of a conductive pin 262, which is longer than the other pins in the box, and its mercury-cup is connected with the coils of the relay-magnet 263. The record-controlled circuit includes and is controlled by the armature of this relay. The pin 262 is so located in the pin-box that the pin always comes in contact with an unpunched portion of a properly-located card, so that if a card is in proper position in the machine the pin will be held back and no circuit will be established through the coils of the relay 263. Then when the shorter pins contact with the mercury in their cups, the circuit will be closed through the counters 81 and the armature of the relay. If, however, no card be in the machine, the pin 262 will enter its cup and close the circuit through the relay-coils before the counter-circuit is completed through the shorter pins, and the energizing of the relay-coils will attract the armature, breaking the counter-circuit, and the counters will therefore not be operated.

It will be understood that many other modifications may be made in the form, construction, and arrangement of the apparatus herein described. Different methods of arranging the electrical circuits may also be substituted for those which I have shown herein, and the method of arranging the circuits and connecting the machines will be varied to agree with the scheme of compilation and the character of the data. For instance, the records may be formed in a continuous strip and presented successively to the operation of the compiling or sorting devices, and then each record may be severed from the strip by appropriate mechanism and delivered into its proper compartment.

I have before stated that the registering apparatus described and claimed in my pending application, Serial No. 34,019, may be employed instead of the electromechanical counters which I have described as applicable for the counting of units. In case such apparatus be substituted for the counters it will be necessary to connect the two machines, so that they will operate in exact synchronism. For instance, the shaft 106 shown in the accompanying drawings may be the same shaft as the shaft 42 in the machine illustrated in my said pending application, the only requirement being that the gear 74 of said machine should rotate with the gear 108 of the machine therein described. It will also be understood that two or more of the machines herein described may be connected to operate consecutively in connection with the machines just referred to. In that case, however, it will be necessary to adjust the gears of each machine so that their regular and periodic consecutive action will be insured.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination with a plurality of record-controlled registering-counters, of means for supporting a plurality of the counter-controlling records, means for moving the records singly into position to control the operation of the counters, a plurality of sorting-compartments and means controlled by the records for delivering each one to its proper compartment.

2. The combination with a plurality of record-controlled registering-counters, means for feeding the counter-controlling records singly into position to control the operation of the counters, a plurality of sorting-compartments and means controlled by the records for delivering each one to its proper

partment after the control of the counters thereby has been effected.

3. In apparatus of the character described the combination of a plurality of record-cards, a support for said cards, means for removing them from said support singly and feeding them one by one into operative position, a plurality of sorting-compartments and means controlled by the record-cards for delivering a card to its proper sorting-compartment at each operation of the machine.

4. In apparatus of the character described the combination of a support for a plurality of record-cards, means for successively removing the cards from said support and feeding them singly into operative position, a plurality of sorting-compartments, means for feeding the record-cards into said compartments and selecting means controlled by the record-cards for determining the compartment into which each record shall be delivered.

5. In apparatus of the character described the combination with registering devices, of a plurality of cards each containing a record adapted to control the operation of registering devices, a support for said cards, means for feeding them singly into a position in which they may control the operation of the registering devices, a plurality of sorting-compartments and means controlled by the record-cards while in said position to deliver one card into its proper sorting-compartment at each operation of the machine.

6. In apparatus of the character described the combination of a support for a plurality of record-cards, means for feeding the cards into operative position, a plurality of sorting-compartments, means controllable by the records for delivering a record-card to its proper compartment at each operation of the machine and means controlled by the record-cards for actuating said feeding and delivering means.

7. In apparatus of the character described, the combination of means for feeding the records successively into operative position, means for supporting each record in such position, a plurality of sorting-compartments, means controlled by the record for obstructing the entrance to all but one of said compartments at each operation of the machine, and means controlled by the record for delivering it to the compartment to which the entrance is unobstructed.

8. In apparatus of the character described, the combination of a plurality of sorting-compartments, a plurality of deflectors controlling the entrance to such compartments, means for operating said deflectors to effect such control, record-controlled means for determining which of said deflectors shall be operated at each operation of the machine and means controlled by the record for returning said deflectors to their normal position.

9. In apparatus of the character described, the combination of a plurality of sorting-compartments, means for feeding the records to [illegible] compartments, electrically-operated devices for establishing communication with one only of such compartments at each operation of the machine, record-controlled circuit-closing means for determining the compartment with which such communication shall be established and means controlled by the record for delivering the record to such compartment.

10. In apparatus of the character described the combination of a support for a plurality of record-cards, means for feeding the cards edgewise into operative position, a plurality of sorting-compartments, and means controllable by the record-cards for delivering a record-card to its proper compartment at each operation of the machine.

11. In a continuously-operable machine of the character described the combination of a support for a plurality of records, means for engaging said records and feeding them successively to their operative position, means for supporting them in such position, a plurality of compartments for receiving the records, means for determining the compartment into which each record shall be delivered, means for delivering each record to its predetermined compartment and means controlled by the record for operating successively and coöperatively the feeding and delivering devices at each operation of the machine, substantially as set forth.

12. In apparatus of the character described, the combination of a plurality of record-receiving sorting-compartments a plurality of electromagnets each controlling the entrance to one of such compartments, circuit-controlling devices for each magnet, record-controlled means for governing the action of the circuit-controlling devices and determining which compartment shall receive the record and means also controlled by the record for delivering the same into such compartment.

13. In apparatus of the character described the combination of a plurality of sorting-compartments to receive the record-cards, means for delivering the cards into such compartments, means for determining the compartment which shall receive the card comprising selecting devices having two relatively movable members and means for feeding the record-cards singly between said members to control the operation of the selecting devices and the delivery of the cards.

14. In apparatus of the character described the combination of a plurality of sorting-compartments to receive the record-cards, means for delivering the cards singly into the compartments, circuit-closing devices by which the delivery of each record into its proper compartment is controlled, means for feeding the record-cards between the terminals of the circuit-closing devices and means for actuating the latter to complete a circuit through a perforation or perforations forming the record on the card.

15. In apparatus for compiling statistics and the like from records, the combination of compiling apparatus, means controlled by the

records for actuating the compiling apparatus, a support for a plurality of the records, devices for feeding the records from said support and presenting them singly to the action of the means by which the compiling apparatus is actuated and means for actuating successively and coöperatively the record-feeding devices and the compiling apparatus.

16. In apparatus for compiling statistics and the like from records, the combination of a support for a plurality of records, a plurality of registering devices, electromagnets controlling the operation of the registering devices, circuit-controlling devices controllable by the records and in circuit with the magnets, means for feeding the records from their support and presenting them singly to the circuit-controlling devices and means for actuating successively and coöperatively the record-feeding means and circuit-controlling devices.

17. In apparatus for compiling statistics and the like from records, the combination of a support for a plurality of records, a plurality of registering devices, circuit-controlling devices controllable by perforations in the records and in circuit with the magnets, means for feeding the records from their support and presenting them singly to the circuit-controlling devices and means for actuating successively and coöperatively the record-feeding means and circuit-controlling devices.

18. The combination of a support for a plurality of records, means for feeding the records singly into operative position, registering devices, electromagnets controlling the operation thereof, circuit-closing devices in circuit with the magnets, means for actuating the circuit-closing devices by perforations in the records, means for operating successively and coöperatively the record-feeding and circuit-closing devices and means for removing the records from their operative position independent of the feeding devices.

19. In apparatus of the character described the combination of compiling apparatus, record-controlled means for actuating said apparatus, means for supporting a plurality of the records, devices for feeding the records and presenting them singly in operative position, means also controlled by the record for actuating successively and coöperatively the record-feeding devices and compiling apparatus.

20. In a continuously-operable, record-controlled apparatus for compiling records, the combination of a support for a plurality of records, means for engaging said records and feeding them successively to their controlling position, means for supporting them singly in such position, registering devices for compiling the data on the records, means for operating the registering devices in accordance with each record, means for removing each record from its controlling position and means controlled by the record for effecting successively and coöperatively the feeding, the compilation and the removal of the record, substantially as set forth.

21. In a continuously-operable, record-controlled apparatus for compiling and sorting records, the combination of a support for a plurality of the records, means for engaging said records and feeding them successively to their controlling position, means for supporting them in such position, registering devices for compiling the data on the records, means for operating the registering devices in accordance with each record, a plurality of compartments for receiving the records, means for determining the compartment into which each record shall be delivered, means for delivering each record to its predetermined compartment and means for operating successively and coöperatively the feeding, compiling and delivering devices at each operation of the machine, substantially as set forth.

22. In apparatus of the character described, the combination of a support for a plurality of cards, a feed-slot, a reciprocating card-engaging device for carrying the card through the feed-slot, feed-rolls for engaging the card below the slot, a movable support for receiving the card when it is in operative position and ejector-rolls below said support for engaging the card after said support has been withdrawn, substantially as shown and described.

23. In apparatus of the character described, the combination of a support for a plurality of cards, a feed-slot, a reciprocating card-engaging device, for carrying the card through the feed-slot, feed-rolls for engaging the card below the slot, a movable support for receiving the card when it is in operative position, ejector-rolls below said support for engaging the card after said support has been withdrawn and rolls intermediate the feed and ejector rolls for carrying the card from its operative position to the ejector-rolls, substantially as shown and described.

24. In apparatus of the character described, the combination of reciprocating selecting devices arranged to coöperate with a record-card and means actuated when said devices are reciprocated to secure correct registration of the card with the selecting devices, substantially as shown and described.

25. In apparatus of the character described, the combination of record-controlled selecting devices, means for feeding the record, means for arresting the movement of the record at a predetermined point and centering devices actuated by the movement of the selecting devices for moving the record across its feeding direction, to secure correct registration of the record with the devices controlled by it, substantially as shown and described.

26. In apparatus of the character described, the combination with a reciprocating frame carrying record-controlled mechanism, of movable centering-fingers arranged in the path of said frame and actuated thereby for

securing the registration of the record with the mechanism controlled thereby.

27. In apparatus of the character described, the combination of record feeding and delivering mechanism, a motor, devices for connecting said mechanisms and the motor, means for maintaining such connection independent of the record, means controlled by the record for maintaining such connection and means for transferring the control of such connection to the record while the record is in operative position, substantially as shown and described.

28. In apparatus of the character described, the combination of record feeding and delivering devices, circuit-closing devices controlled by the record, a motor, releasable connections between the motor and the feeding and delivering devices, a magnet controlling such connections, a circuit controlled by the record, a circuit controlled independently of the record and means for transferring the control of the magnet from the independently-controlled to the record-controlled circuit when the latter is established.

29. In apparatus of the character described, the combination of record-controlled contacts, mechanism for feeding records successively thereto, a motor, electrically-operated connections between the feeding mechanism and the motor, record-controlled contacts for maintaining the connections between the motor and the feeding mechanism, contacts controlled by the motor for maintaining such connections independently of the record-controlled contacts and means for actuating the motor-controlled contacts to release their control of said connections when the latter are under the control of the record-controlled contacts.

30. In apparatus of the character described, the combination of electrically-operated compiling apparatus, mechanism for feeding the records singly thereto, a motor, electrically-operated connections between the feeding mechanism and the motor, contacts controlled by the records for actuating the compiling apparatus and maintaining the connections between the motor and the feeding mechanism, contacts controlled by the motor for maintaining such connections independently of the compiling-apparatus contacts, and means for actuating the motor-controlled contacts to release their control of said connections when the compiling apparatus is operated.

31. In apparatus of the character described, the combination of electrically-operated compiling apparatus, mechanism for feeding the records singly thereto, a motor, electrically-operated connections between the feeding mechanism and the motor, contacts controlled by the record for actuating the compiling apparatus and maintaining such connections, contacts controlled by the motor for maintaining such connections independently of the compiling-apparatus contacts, means for actuating the motor-controlled contacts to release their control of said connections when the compiling apparatus is operated, and means for reëstablishing the control of the motor-controlled contacts.

32. In apparatus of the character described, the combination of a reciprocating frame, record-controlled contacts carried thereby and a yielding pressure-plate carried in advance of said frame for engaging the record, substantially as shown and described.

33. In apparatus of the character described, the combination of a reciprocating frame, record-controlled pins carried by said frame and a record-engaging plate provided with apertures for said pins and yieldingly supported in advance of the pins, substantially as shown and described.

34. In apparatus of the character described, the combination of a reciprocating frame, record-controlled pins carried by said frame, a record-engaging plate carried by said frame and provided with apertures for the pins and means for yieldingly supporting said plate in advance of the frame.

35. In apparatus of the character described, the combination with an electric circuit of a plurality of conductive pins, a contact device by which the pins are connected to the circuit and means controlled by the records for actuating said contact device, substantially as shown and described.

36. In apparatus of the character described, the combination with an electric circuit of a frame carrying a plurality of conductive pins normally disconnected from the circuit, a contact carried by said frame and means controlled by the records for actuating said contact to connect the pins to the circuit, substantially as shown and described.

37. In apparatus of the character described, the combination with an electric circuit of a frame carrying a plurality of conductive pins normally disconnected from the circuit, a contact carried by said frame, and a spring-pin carried by the frame and arranged to engage with the record and connect the conductive pins with the circuit, substantially as shown and described.

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No. 12,523. REISSUED AUG. 28, 1906.

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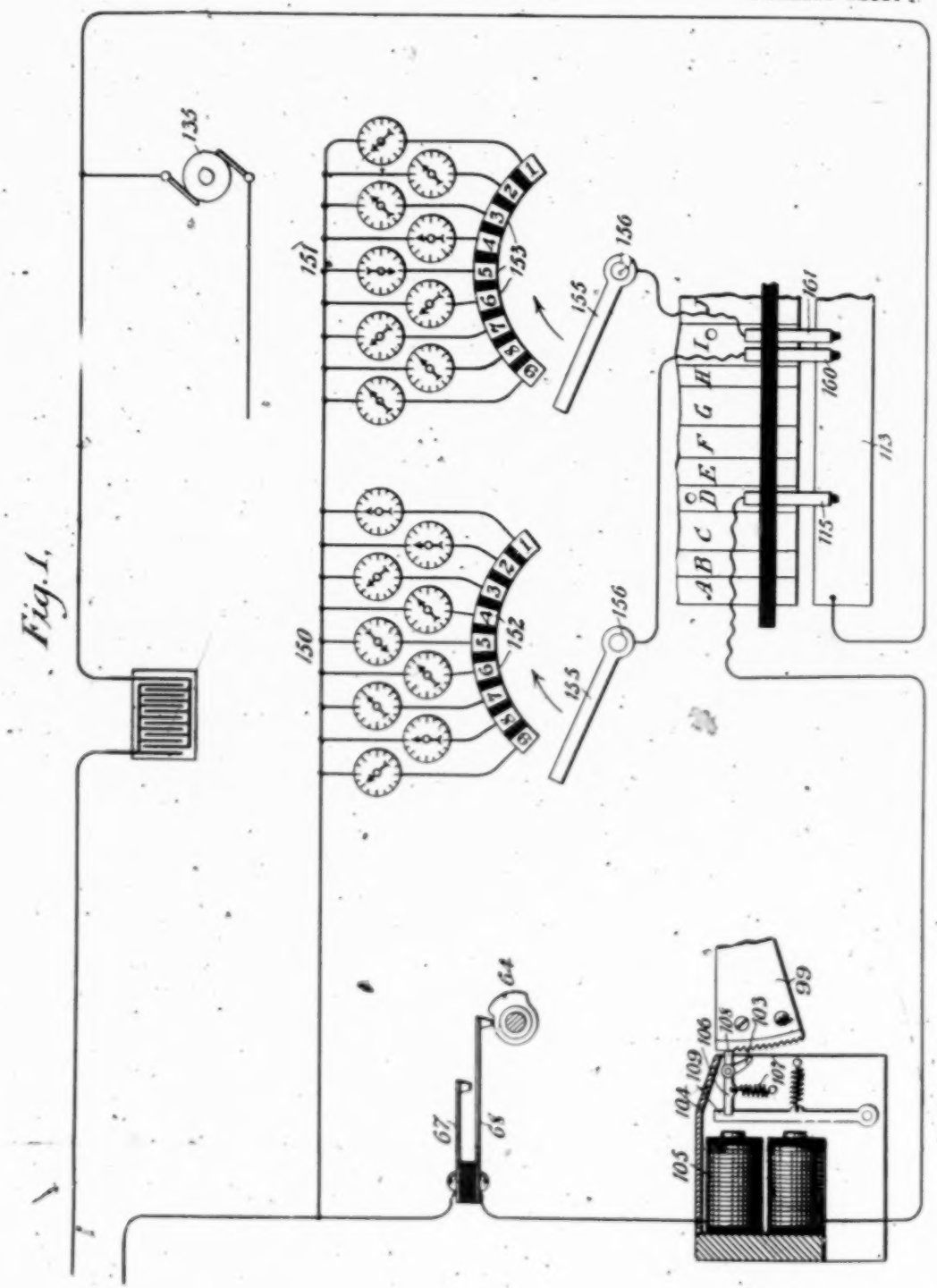
APPARATUS FOR USE IN TABULATING SYSTEMS.

APPLICATION FILED JULY 25, 1906.

8 SHEETS—SHEET 1.

Fig. 1.



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8 SHEETS—SHEET 2.

Fig. 2.

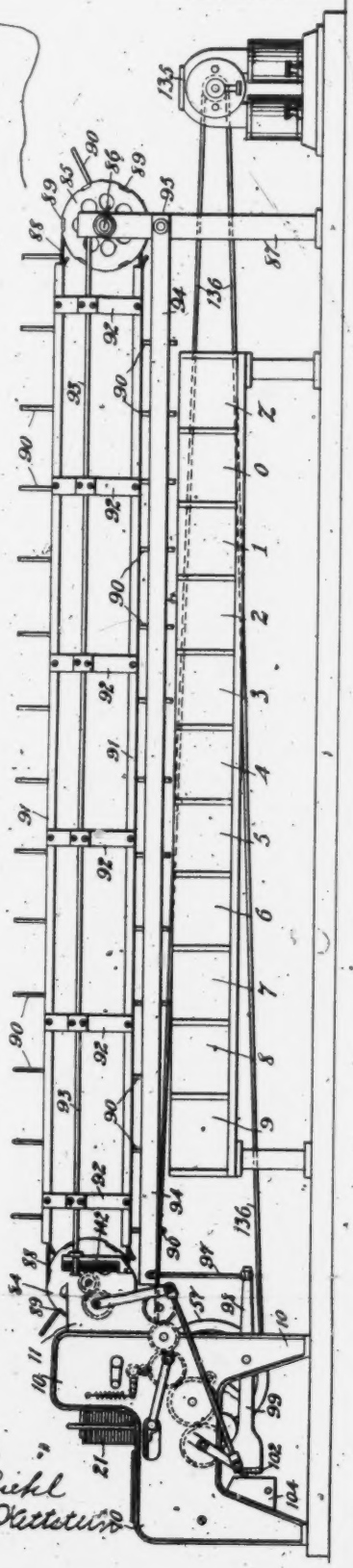
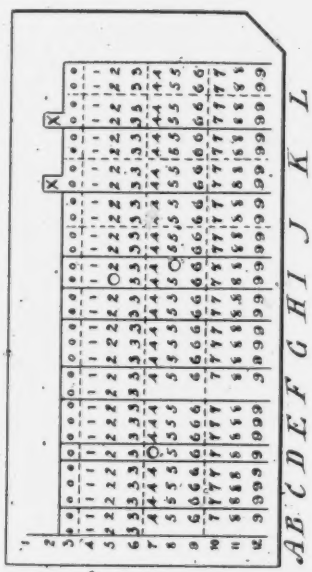


Fig. 11.



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8 SHEETS—SHEET 3.

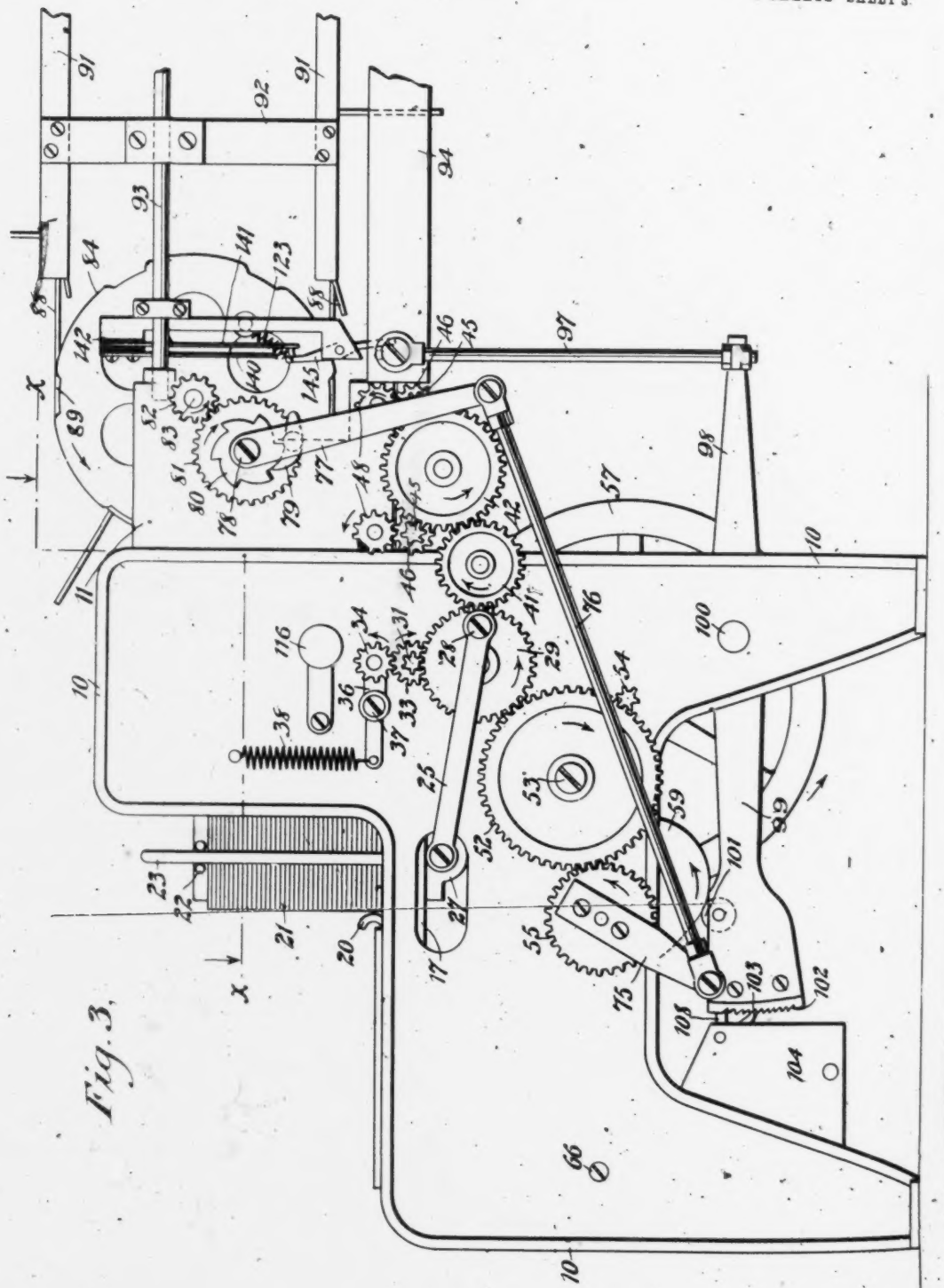

Fig. 3.

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8 SHEETS—SHEET 4.

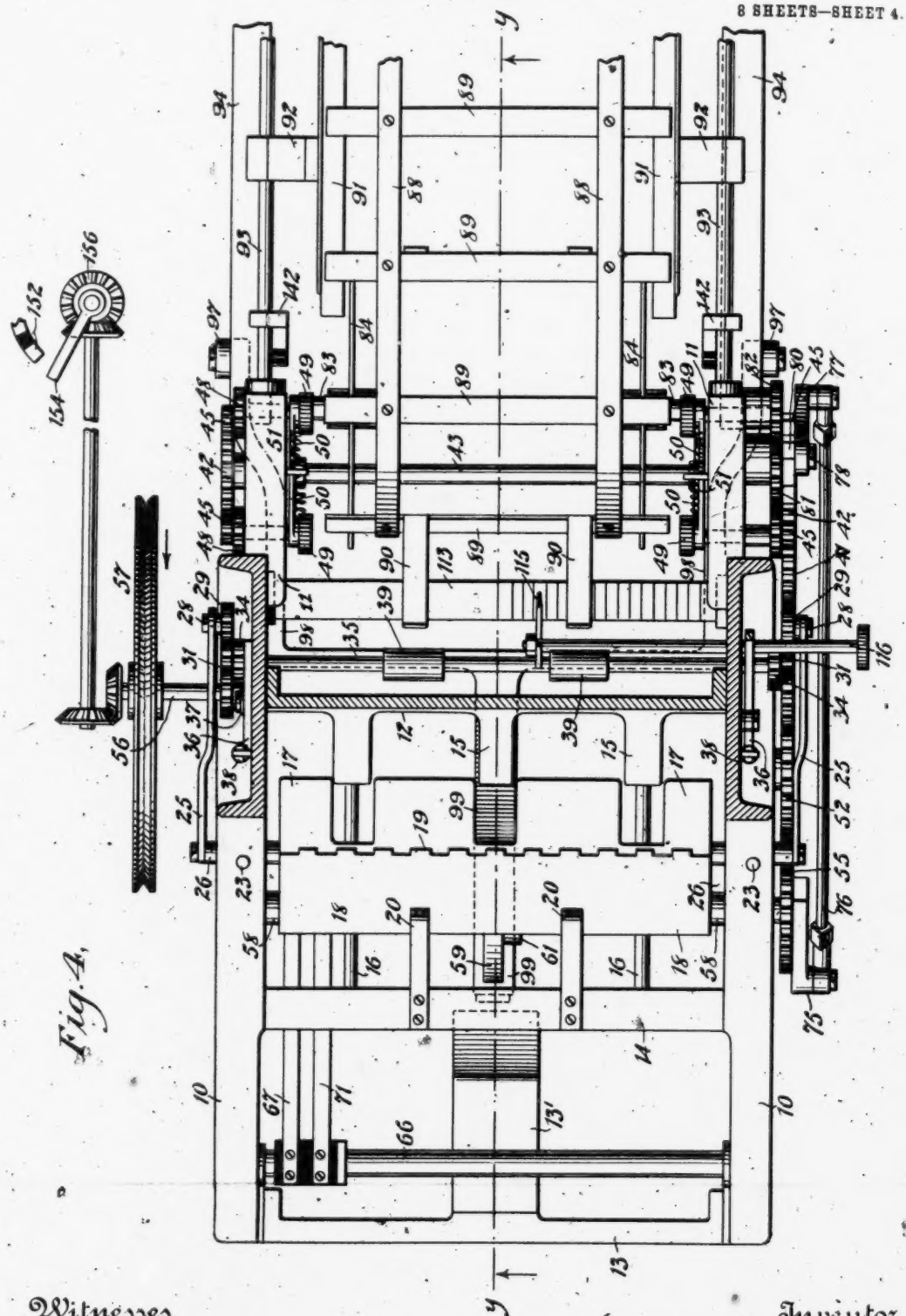

Fig. 4.

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8 SHEETS—SHEET 5.

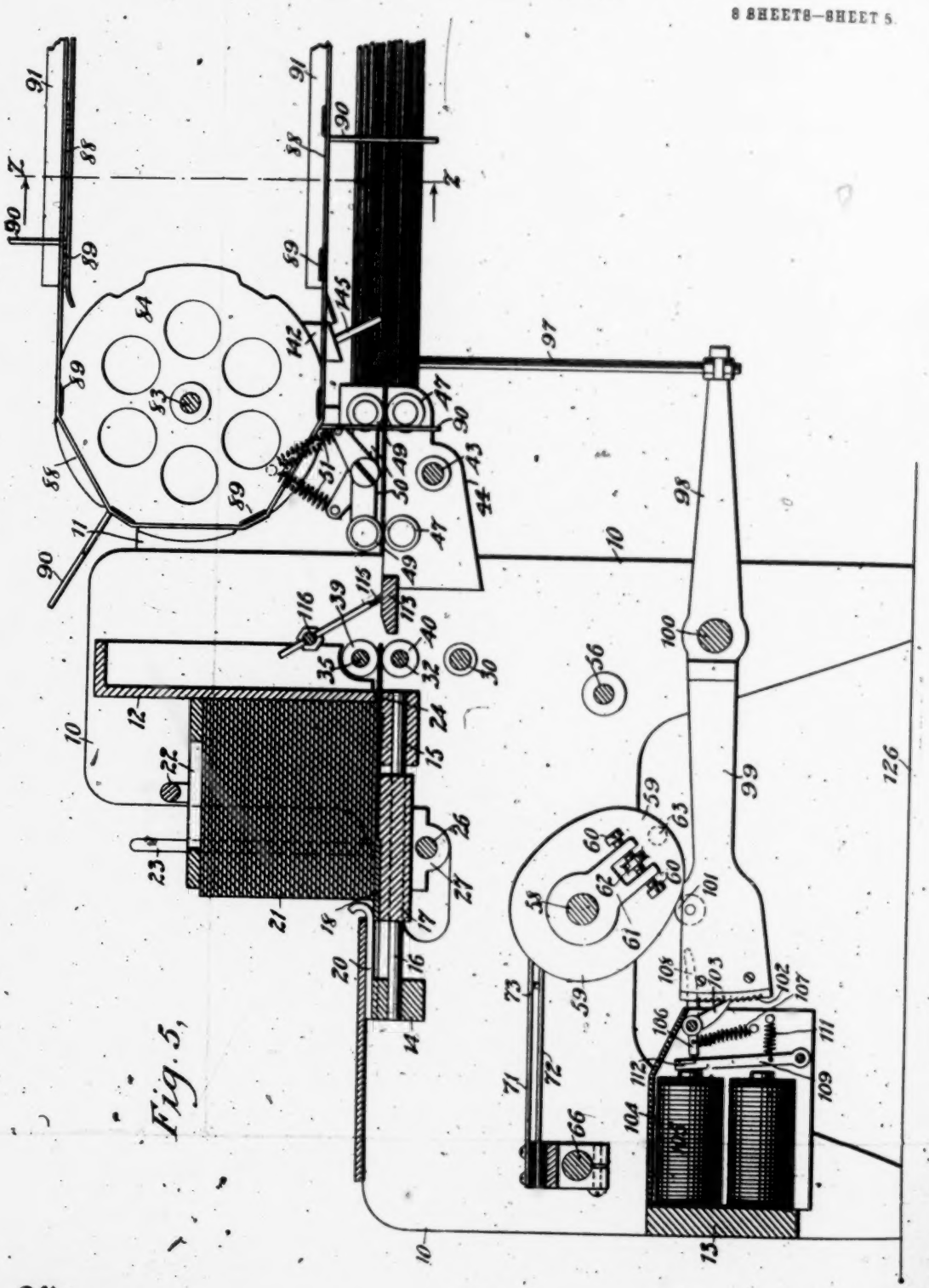

Fig. 5.

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APPLICATION FILED JULY 25, 1906.

8 SHEETS—SHEET 6.

Fig. 6.

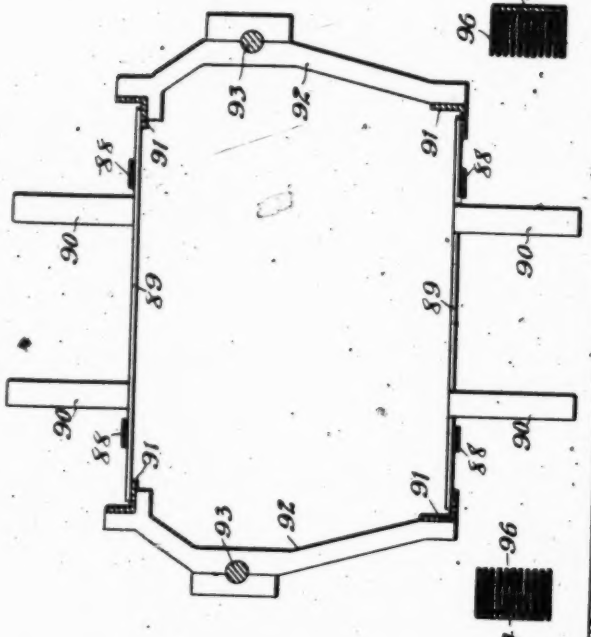


Fig. 7.

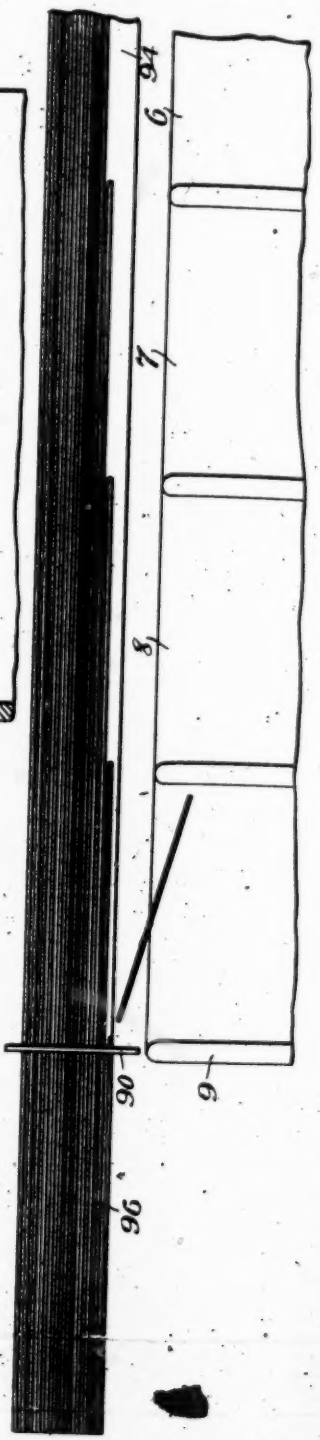


Fig. 8.

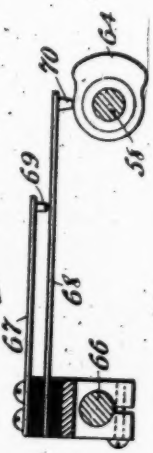
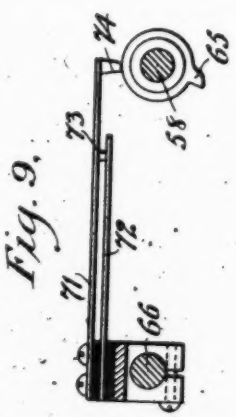


Fig. 9.



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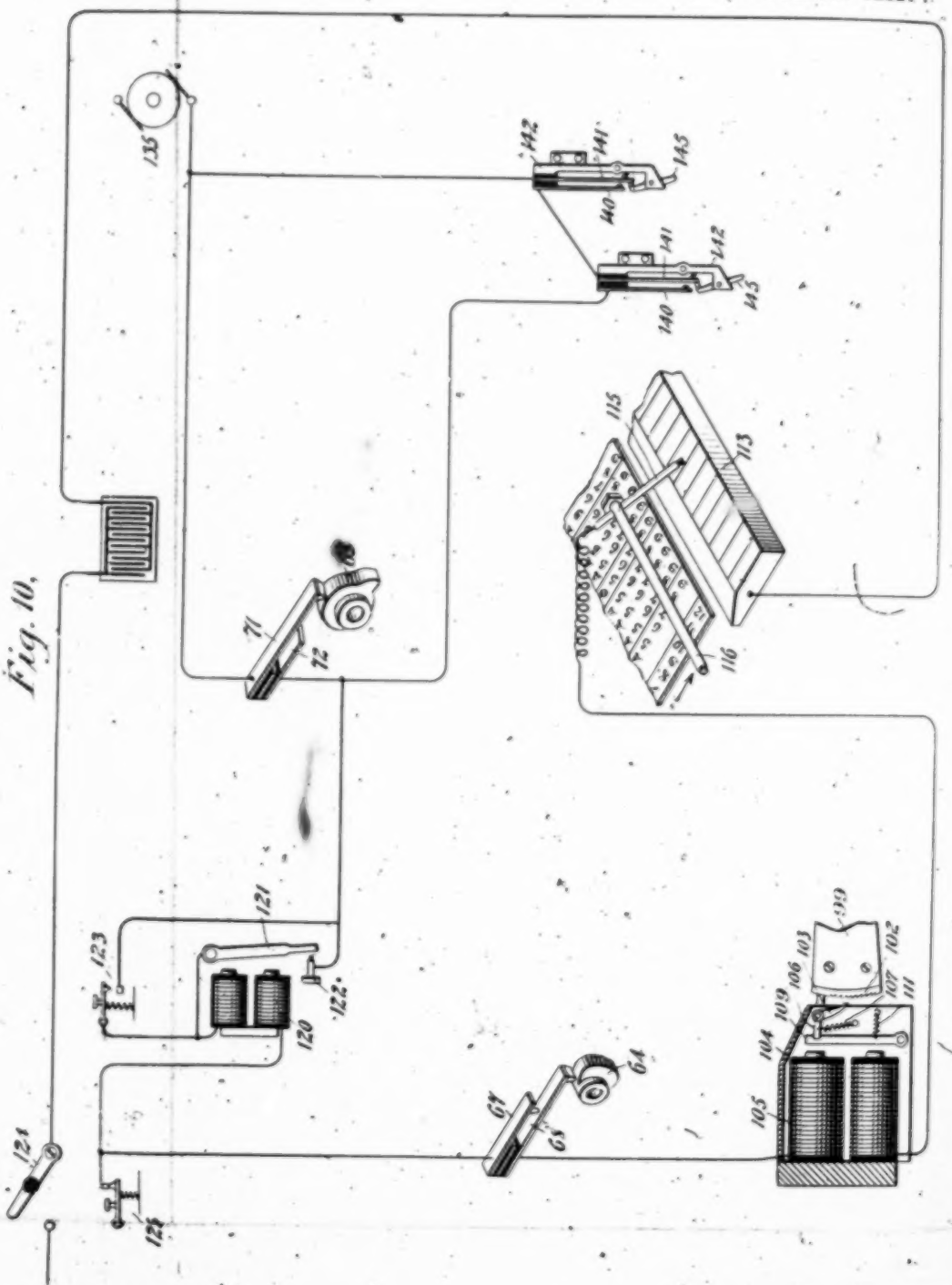
APPARATUS FOR USE IN TABULATING SYSTEMS.

APPLICATION FILED JULY 25, 1906.

8 SHEETS—SHEET 7.

Fig. 10.



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No. 12,523. REISSUED AUG. 28, 1906.

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APPARATUS FOR USE IN TABULATING SYSTEMS.

APPLICATION FILED JULY 25, 1906.

8 SHEETS—SHEET 8.

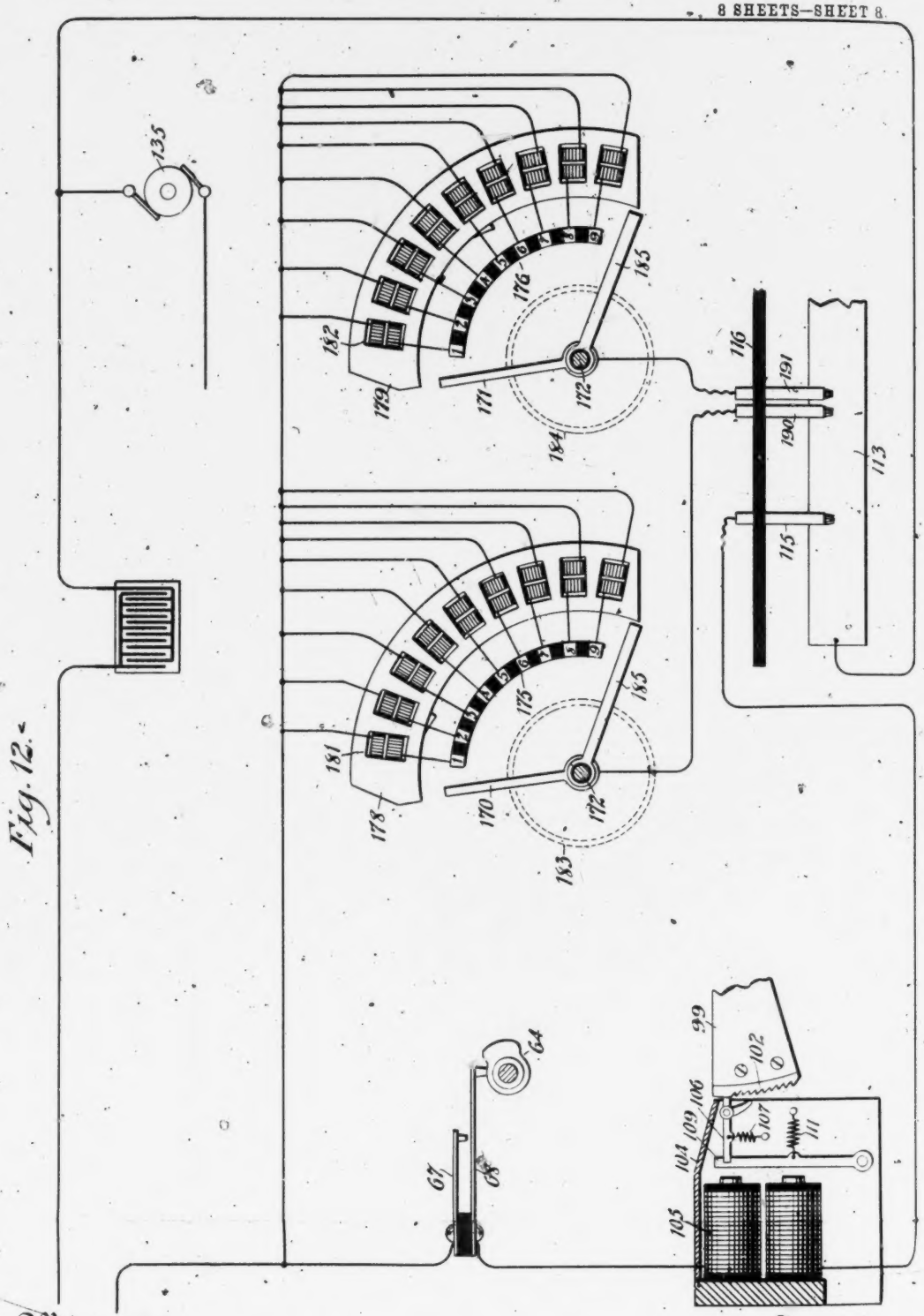

Fig. 12.

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By his Attorney Symmes

UNITED STATES PATENT OFFICE.

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APPARATUS FOR USE IN TABULATING SYSTEMS.

No. 12,523. Specification of Reissued Letters Patent. Reissued Aug. 28, 1906.

Original No. 777,209, dated December 13, 1904. Application for reissue filed July 25, 1906. Serial No. 327,789.

To all whom it may concern:

Be it known that I, HERMAN HOLLERITH, a citizen of the United States, residing in Garrett Park, Montgomery county, Maryland, have invented certain new and useful Improvements in Apparatus for Use in Tabulating Systems, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification.

The object of this invention is primarily to provide means and apparatus for use in the Hollerith tabulating system by which the records employed in that system may be tabulated and the results thereof counted or compiled by a suitable register or series of registers and by which the records may be classified.

The records employed in the Hollerith system consist, preferably, of separate cards upon which index-points are formed by punching holes through the cards, the value or character of the item thus recorded being denoted by the position of the index-point. In the most efficient form in which the system has been developed the index-points on the cards control electric circuits which are closed through the holes when the records are in operative position; but it is to be understood that my invention is not limited to use in any particular system or with any particular classes of records or to any special arrangement of or means of forming the index-points or to the employment of an electric circuit or circuits.

With this general reference to the character of my invention I will now proceed to describe a preferred form of apparatus which embodies the features thereof and the operation of which, as it has been used successfully for that purpose, I will explain in connection with the tabulation and sorting of records containing data relating to the transportation of freight. I will not attempt to describe in detail the complete method of tabulating freight statistics or the numerous classifications of the records that are effected in that work and will refer to only so much thereof as will be necessary to explain the construction and operation of the apparatus illustrated.

A typical record arranged for use in the compilation of freight-transportation statistics is shown in Fig. 11. Each such record or "record-card," as I have herein termed it, represents a way-bill, and when properly punched contains all the information relating to each consignment which it is desired to tabulate. The record shown, which is about half-size, is provided with twelve groups or divisions of index-point positions, which provide for the designation of (A) the month and (B) the day of shipment, (C) the receiving-station, (D) the line by which the shipment was made, (E) the forwarding-station, (F) the forwarding date, (G) the way-bill number, (H) the commodity, (I) the weight, (J) the proportional charge, (K) advances, and (L) prepaid charges. The index-point positions are denoted by numerals printed in columns on the cards, and each group comprises one or more columns, as required. Taking groups D and I as examples, each road or section of road over which the shipment may be made is represented by a number. To designate the road, the corresponding numeral is punched in group D, while the weight of each shipment up to ninety-nine pounds may be designated in group I by punching the corresponding numerals therein. For the sake of brevity I have shown only two columns, the right-hand column representing units and the left-hand tens. In practice a greater number of columns is generally employed to provide for shipments weighing more than ninety-nine pounds. In tabulating the records the totals of weight and values are compiled or counted by suitable registering devices—for instance, like those shown in United States Letters Patent No. 395,781, granted to me January 8, 1889—and either in connection with such tabulation or by a distinct operation the cards, in order to obtain a proper subdivision of the data, are sorted into groups according to the data on the cards. Thus it may be desired to obtain the total weight of shipments for a certain period and at the same time to sort or classify the records relating to these shipments according to the road or section of road over which the shipments were made. This may be accomplished by the particular form of apparatus illustrated in the accompanying drawings, in which—

Figure 1 is a diagrammatic view of the electric circuits and devices employed in the registering apparatus. Fig. 2 is a side elevation of a record-sorting apparatus; Fig. 3, a side elevation, on a larger scale, of the part shown in Fig. 1 at the left of the drawings; Fig. 4, a sectional plan of the mechanism shown in Fig. 2 on and below the plane *x x*; Fig. 5, a sectional elevation thereof on the plane *y y*, Fig. 4, viewed in the direction indicated by the arrows; Fig. 6, a sectional detail on the plane *z z*, Fig. 5, viewed in the direction indicated by the arrows; Fig. 7, a detail illustrating the construction and operation of certain devices by means of which the cards are conveyed to and deposited in separate groups; Fig. 8, a detail of a circuit-controlling device; Fig. 9, a detail of another device of a similar character; Fig. 10, a diagrammatic view of electrical circuits and connections by which the sorting devices are operated; Fig. 11, a view of a record-card, and Fig. 12 a diagrammatic view showing a modified form of counters or registers.

Similar reference characters designate like parts in all views.

Referring first to the sorting apparatus, it will be understood that the cards may be sorted or classified under any of the first eight groups shown on the card illustrated in Fig. 11, and I will therefore describe the operation of the machine in sorting the cards according to the line or road of shipment, the data being embodied in group D of the record-card.

The cards having been properly punched are piled upon a suitable platform and fed one by one into position to effect the operation of circuit-controlling devices which variably govern the action of mechanism according to the location of the index-point of each card to deposit the record in its proper group. The groups are formed by depositing the cards at different points or sorting-stations, and for the purpose of preserving the classification effected by the machine a separate box or compartment is preferably employed to receive each group. These compartments are designated, Fig. 2, by the letter "Z" and the numerals "0" to "9," inclusive.

The frame of the feeding mechanism is composed of standards 10, having extensions 11, and is secured together by cross-beams 12, 13, and 14. Under the cross-beam 12 is a fixed bar on which are blocks 15, that project in front of the cross-beam. Guides consisting of rods 16 are fixed in two of these blocks and in the cross-beam 14 to support the reciprocating cross-head 17. The upper faces of the cross-head 17 and the block 15 are in the same horizontal plane. The blocks 15 and cross-head 17 form the platform on which the cards to be sorted are piled. On the cross-head 17 is a plate 18, whose upper surface is slightly higher than the card-platform. The inner or rear edge 19 of this plate is indented, as appears clearly in Fig. 4. A pair of stationary guide-fingers 20, attached to the cross-beam 14, project thence over the plate 18, the inner ends of these fingers being turned upward, as shown in Fig. 5, and being at a distance slightly greater than the width of the cards from the front face of the cross-beam 12. The cross-head 17 is movable from the position indicated in Figs. 4 and 5 toward the cross-beam 14 far enough to carry the indented edge 19 of the plate 18 even with or under the curved ends of the fingers 20. The pile of cards 21 is laid against the beam 12, and on the pile is put a plate or keeper 22, which fits between the standards 10, and in whose lateral edges are pins which embrace the guide-rods 23, fixed in the standards. Between the cross-beam 12 and the bar supporting the blocks 15 is a passage 24, of the proper height to allow only the bottom card of the pile to pass under the cross-beam. The movement of the cross-head 17 from the cross-beam 14 to the position shown in Fig. 5 is sufficient to cause the raised edge 19 of the plate 18 to push the card through the passage 24 far enough to be engaged by the feed-rolls hereinafter described. This motion is imparted to the cross-head 17 by connecting-rods 25, secured to a rod 26, extending through brackets 27 on the cross-head 17 and through openings in the standards 10. The wrist-pins 28 of the connecting-rods are fixed in gears 29, fast on a shaft 30, that extends through and has bearings in the standards. These gears mesh with pinions 31, fast on a shaft 32, extending through bearings on the standards. On the shaft 32, between each of the pinions and the adjacent standard, is a small gear 33. These gears 33 are fast on the shaft 32, and they mesh with similar gears 34, fast on a shaft 35, which extends through holes in the standards and has bearings in arms 36, pivoted to the standards by pins 37, the holes in the standards being large enough to allow the shaft 35 to play up and down. Springs 38, attached to the arms 36, subject the shaft to a yielding downward pressure. Feed-rolls 39 are fixed on the shaft 35, and directly under these rolls are other similar feed-rolls fixed on the shaft 32, one of the latter feed-rolls 40 being shown in Fig. 3. Behind the gear 29, on the side of the frame which is shown in Fig. 3, is an idle gear 41, mounted on a stud fixed in the standard and meshing with the gears 29 and 42. The gear 42 and another similar gear at the other side of the machine are fast on a shaft 43, having bearings in fixed brackets 44, projecting from the standards. The gears 42 mesh with pinions 45, which are fast on studs having bearings in the brackets 44 and carrying also small gears 46 outside of the brackets and feed-rolls 47 inside of the brackets. The gears 46 mesh with similar gears 48, which

actuate the feed-rolls 49, these gears and feed-rolls being carried by the pivoted arms 50. A yielding downward pressure is imposed on the feed-rolls 49 by coil-springs 51, connected with the arms 50. The feed-rolls 47, which are in line with the rolls 40, are arranged to revolve at a higher rate of speed than the rolls 40 in order to facilitate the feeding of the cards. An idle gear 52, which meshes with the gear 29 on that side of the frame which is shown in Fig. 3, is mounted on a stud 53, fixed in the standard. This idle gear also meshes with a pinion 54 and a gear 55. The pinion 54 is fast on a driving-shaft 56, on which is a fast pulley 57 on the other side of the machine. The gear 55 is fast on a shaft 58, having bearings on the standards. On this shaft midway between the standards is a cam 59, which is rendered adjustable to exactly its proper position on the shaft by means of set-screws 60, inserted in a forked block 61 and bearing against a projection 62 on one side of the cam, as appears by Fig. 5, the forked block being fast on the shaft. In the cam is a pin 63. (Indicated by dotted lines in Fig. 5.) On the shaft 58 are two other cams 64 and 65, which actuate the circuit-controlling devices. (Separately shown in Figs. 8 and 9.) These devices are attached to a rod 66, fastened at its ends to the standards and project from this rod over the cams 64 and 65, as appears by Figs. 4, 5, 8, and 9. The device shown in Fig. 8 comprises upper and lower insulated spring-conductors 67 and 68, having on their under sides projections 69 and 70, respectively. The projection 70 is always in contact with the cam 64, and when it is in the position shown in Fig. 8 the projection 69 is not in contact with the conductor 68. During each revolution of the cam the projection 70 is raised by the action of the cam upon it, and contact of the conductor 68 with the projection 69 is established and maintained for a suitable interval, after which it is broken and remains broken until it is again established by the cam, as described. The device shown in Fig. 9 comprises upper and lower insulated spring-conductors 71 and 72, the upper conductor having on its under side projections 73 and 74. These projections are in contact with the strip 72 and the cam 65, respectively, except when the contact of the projection 73 with the strip 72 is broken by the lifting action of the cam on the projection 74. This contact is instantly reëstablished by the resilient action of the strip 71 when the projection 74 is allowed to descend from its elevated position. The cams 59, 64, and 65 are all arranged to make a complete revolution for one complete reciprocation back and forth of the cross-head 17.

To a crank 75, affixed to the gear 55, is secured a connecting-rod 76, which is pivotally attached to a pawl-carrying lever 77, secured to one of the extensions 11 of the frame by a pin 78 passing loosely through the lever. The pawl 79 on the lever engages with a ratchet 80, fastened to a gear 81, which meshes with a gear 82, fast on a shaft 83, having bearings on the extensions 11 of the frame. Sprocket-wheels 84 and 85 are mounted on shafts 83 and 86, respectively, Fig. 2, (the latter being journaled in posts 87,) and actuate a traveling card-engaging device comprising endless flexible bands 88, to which are attached slats 89, the ends of which engage with the sprockets 84 and 85, as appears by Figs. 2, 4, and 5. To these slats at regular intervals are attached fingers 90, which extend outward from the slats between the bands. The carrier is supported between the wheels 84 and 85 by angle-rails 91, Fig. 6, on which the slats slide, the angle-rails being fastened to brackets 92, through which extend rods 93, fixed in the posts 87, and the extensions 11 of the frame. The carrier is driven intermittently or step by step through the shaft 83, gears 82 81, pawl and ratchet 79 and 80, levers and connections 75, 76, and 77 from the gear 55.

The guides by which the cards are conducted to the different sorting stations or compartments consist of two plates 94, pivoted one on each side of the apparatus to the posts 87. The plates are each provided with a series of independent channels 96 of successively-increasing length, one above the other, of sufficient depth and width to receive and support the ends of the cards, the distance between the plates 94 being slightly greater than the length of the cards, and they are held in parallelism at one end by the posts 87 and at the other by the pivotally-connected rods 97, which are also connected with the arms 98 of the bifurcated lever 99. The lever 99 is pivotally mounted on the shaft 100 between the standards 10, and near the left-hand end of the lever is mounted a friction-roller 101, which engages with the cam 59, being held in contact therewith by the weight of the guides 96 and their connected parts. The guides 96, which in the particular embodiment of my invention herein illustrated are immovable relatively to each other, are by the joint action of the cam on the lever 99 and the weight of the guides reciprocated across or partly across the path of movement of the cards at each revolution of the cam, which is arranged to revolve once for each complete reciprocation of the cross-head 17. One channel or guide is provided for each sorting station or compartment, the lowest one terminating at the station nearest the operative position of the card, the next one at the next compartment, and so on, successively, as will be seen by reference to Fig. 7, so that as a card is carried through one of the guides it will fall into the compartment at which that guide terminates. Upon the

front end of the lever 99 is a series of ratchet-teeth 102, one for each card-guide, and a pawl 103 is pivoted in the housing 104 of the magnet 105. The pawl 103 is provided with an arm 106, to which is attached a coil-spring 107, and with an arm 108, which lies in the path of the pin 63 on the cam 59. The magnet 105 and its housing are carried by the cross-beam 13. The spring-retracted pivoted armature 109 of the magnet is notched at 112 to receive and hold the end of the arm 106. The parts just described are so adjusted relatively to each other that when the uppermost of the guides 96 which comunicates with the station or compartment Z is exactly in position to receive a card from the delivery-rolls, the lowermost of the ratchet-teeth 102 will be in position to be engaged by the pawl 103.

The particular embodiment of my invention which I have selected for description and illustration is adapted and arranged for electrical operation. The electrical features comprise a circuit controlled by the record-card, which includes two separable contacts, one of which is the insulated conducting-plate 113, supported by the standards 10. The cards pass across this plate on their way from the pile 21 to the guides 96. Preferably this plate is graduated by lines to correspond with the division or group of the cards. The other contact consists of a conducting-brush 115, suitably connected to the circuit and secured to an insulating-rod 116, so as to normally contact with that division of the plate 113 to which it may be adjusted. These contacts are separated and this circuit is broken at this point when a card is inserted between them, and it is closed when the card is removed or when a hole in the card permits the resilient brush 115 to contact with the plate 113. This card-controlled circuit includes the coils of the magnet 105 and the spring-contacts 67 and 68, which are actuated by the cam 64. In parallel relation with the record-controlled circuit is a circuit which I term the "motor-circuit" and which includes the starting relay-magnet 120, the contact-springs 71 and 72, which are controlled by the cam 65, and an electromotor 135, by which the apparatus is operated. A branch circuit is also provided around the contact-springs 71 and 72, which includes the normally separated spring-contacts 140 and 141. The armature 121 of the relay-magnet 120 is arranged to make and break the motor-circuit at the contact 122, and a normally open branch circuit, which includes the switch 123, is arranged around the contact 122. A main switch 124 is provided at any convenient point in the line. The driving-pulley of the motor 135 is connected by a belt 136 with the pulley 57 on the shaft 56. A normally closed switch-key 125 is provided at any convenient point in the machine by which the circuit can be instantly opened and the machine stopped.

I will now describe as a separate operation the sorting of cards by the apparatus according to the line or road by which the shipments were made, the index-point positions for which are in the fourth column or group on the card, and afterward as a distinct operation the tabulation of certain data on the cards, and I may mention at this point that as certain groups on the cards contain a plurality of columns it is necessary with the particular form of apparatus shown to sort the cards for such groups separately for each column, as will be readily understood.

The punched cards are placed all the same way in a pile 21 upon the blocks 15 and 17, constituting the card-platform. The brush 115 is then adjusted in position to contact with the subdivision on the plate 113, which corresponds to this fourth column of the card. The main switch 124 being closed, the key-switch 123 is closed to energize the magnet 120, which attracts its armature to the contact 122 and holds it there, closing the circuit through the motor and starting the apparatus. This causes the reciprocation of the cross-head 17 through the gears 54 53 29 and connecting-rods 25, and the edge of the plate 18, engaging the edge of the bottom card in the pile 21, forces it through the slot 24 into engagement with the feeding-rollers 39 and 40, by which it is fed across the plate 113 between it and the brush 115 and into engagement with the rollers 47 and 49. As the card reaches the position in which the hole which may have been punched in the column or group D comes under the resilient brush 115 the latter will contact with the plate 113 underneath and close at that point the circuit which includes the coils of magnet 105. Simultaneously with the separation of the brush 115 and plate 113 by the advancing card this circuit is closed between the contact-springs 67 and 68 by the cam 64, which is so adjusted that the spring 68 is then lifted into contact with the spring 67 and is held there until the card is about to pass from under the brush. The object of this is to prevent the closing of the magnet-circuit and consequent action of the magnet when the spaces between the moving cards permit the brush to contact with the plate. Before the advancing card has reached the brush 115 the revolving cam 59 will have depressed the end of the lever 99, with which it engages, to its lowest point. As the card advances to bring the index-point position denoted by the numeral "9" under the brush 115 the lowermost of the guides 96 will be exactly in line with the moving card and the top one of the ratchet-teeth 102 will be slightly below the engaging end of the pawl 103. As the card advances the guides will descend and the ratchet will ascend proportionally, so that when the nu-

meral "8" reaches the brush the second guide will be in line with the card and the second tooth just below the pawl 103, and so on until the numeral "4" (which it is assumed is the index-point punched in the card now under consideration) reaches its operative position under the brush. When this occurs, as before stated, the magnet-circuit will be closed through the hole in the card and its armature attracted, releasing the pawl 103, which will instantly engage the sixth ratchet-tooth from the top, arresting the upward movement of the lever 99, and holding the sixth guide in line with the card. The two sets of feed-rolls 47 and 49 engaging the card will advance it toward said guide, and while still under the control of the rolls one pair of the intermittently-actuated traveling fingers 90 will engage the rear edge of the card and carry it through the guide until it reaches the end thereof, when it will drop from the guide into the compartment at which the guide terminates and which in the operation just described will be the compartment numbered 4. When the upward movement of the ratchet end of the lever is arrested, the cam 59 continues to revolve and when the lever is arrested in an intermediate position, as shown, the decreasing radius of the cam-surface will cause it to leave the roller, and the guide-lever will be held in its arrested position until the cam in its continued revolution again engages the roller. The further revolution of the cam will depress the lever to its lowest position, and as this occurs the pin 63 will engage the end of the lever 108, lifting the projection 106 and causing it to engage with the notch in the armature 109, as shown in Fig. 10, the magnet 105 having been deenergized to permit the retraction of the armature by spring 111 after the contact between the brush 115 and plate 113 has been broken by the passage of the hole in the card from under the brush. In this manner the parts are reset or restored to normal position ready to be again actuated by the next card which is delivered into the guide and thence into the compartment which corresponds with the index-point on the card. The operation just described is repeated continuously and with great rapidity until all the cards on the platform are sorted.

For the purpose of stopping the operation of the machine automatically when the supply of cards is exhausted I provide in the motor-circuit the normally closed contacts 71 and 72, which are actuated by the cam 65, arranged to revolve once for each delivery of a card and in such relation thereto that the cam separates these contacts momentarily while the advancing card is in engagement with a contact-actuating device or devices arranged in the path of the card in a branch circuit, through which the motor-circuit is opened and closed around the contacts 71 and 72. These contact devices which control the branch circuit around the contacts 71 and 72 are preferably two in number, for reasons to be presently explained, and each consists of the normally separated spring-contacts 140 and 141, suitably insulated and secured to the brackets 142 at each side of the machine, Figs. 3 and 10. The contacts are held apart by the spring-retained detents 145, pivotally secured to said brackets and in such position that the lower end of each detent will project into the path of the cards as they pass through the guides. The advancing card engaging the detent will move it to release the spring-contact 141, which will thus contact with the spring 140 and close the circuit to the motor through the branch until the card passes out of engagement with the detent. At the same time the motor-circuit through contacts 71 and 72 is broken by the cam 65. Hence when the cards are exhausted the motor will continue to operate after the last card is delivered until the revolution of the cam 65 breaks the circuit at the contacts 71 and 72, and as no card then engages the detents 145 the branch circuit also will be open, the apparatus will stop, and the motor-circuit will be permanently broken at the relay 20 by the retraction of the armature from the contact 122. At the beginning of the operation the key-switch 123 is held closed until the first card reaches the detents 145, for unless a card should be in engagement with the detents when the motor-circuit is first broken by the cam 65 the motor will stop. In so far as the automatic stopping of the machine is concerned one card-actuated device 140 141 would suffice; but with two arranged in series and in line with each other at opposite sides of the machine which must be operated simultaneously to close the circuit while the contacts 71 and 72 are open I insure the automatic stopping of the apparatus in case a card should by accident be fed to the guides askew, and thus prevent the blocking of the guides.

I have shown eleven card-sorting stations or compartments, while there are only ten index-point positions in any column on the record-card. This additional compartment is designated by the letter Z, and the top or longest guide of the series 96 communicates with it. The different parts of the apparatus are so adjusted that this top guide will be in position to receive a card when the ratchet end of the lever 99 is in its highest position, so that if in any card no index-point is punched in the column according to which the cards are being sorted, or if the contacts or devices controlled by the card fail to operate properly, the lever 99 will not be arrested by the operation of the magnet, but will rise into its highest position, where it will be held by the cam 59 until this card en-

ters the top guide, through which it is carried to the compartment Z.

The registering or counting apparatus employed for compiling the items in groups I to L comprise a group or series of nine registering-counters for each column of each group of the record to be tabulated. In Fig. 1 I have illustrated two such groups of counters 150 and 151, connected for tabulating the items of weight in group I. These counters, the construction of which is well understood by those skilled in the art, are each actuated by an electromagnet independently connected with the line by a conductor which is common to all the counters, and each time the circuit is closed through any magnet one impulse is imparted thereby to the index-hand of that counter. For each group of counters is provided a series of insulated contacts 152 and 153. The contacts of each series are separately and successively connected to the counters of each group. Contact-arms 154 155, one for each group, are mounted upon a shaft arranged to revolve synchronously with the movement of the card-feeding mechanism by means of suitable connections—such, for example, as the gears and shaft shown in Fig. 4. The arm 154 passes over and contacts with the contacts 152, and the arm 155 passes over and contacts with the contacts 153 at each revolution. The arm 154 is electrically connected with the conducting-brush 160, and the arm 155 is similarly connected with the brush 161. The brushes 160 and 161 are similar to the brush 115, heretofore described, and are supported by the insulating-rod 116. As will be understood, they may be adjusted on their support so as to traverse any column of figures in groups I to L of the card, and it will also be apparent that when a group contains more than two columns of index-point positions one brush and one group of counters for each column will be employed. The movements of the arms 154 155 and of the card are so related that each arm will pass over the left-hand contact of its group or segment as the index-point position denoted by the numeral "9" is passing under the brush and will pass over the right-hand contact as the index-point position denoted by the numeral "1" is under the brush, so if, for instance, the index-point positions be punched in group I to denote "25" (the "2" in the tens and the "5" in the units column) when the hole in the units-column is under the brush the arms 154 and 155 will be in contact with the contacts marked 5 and the circuit will be closed through the brush 161, arm 155, contact 5 of group 153 and the coils of the magnet of the corresponding counter of the group 151 to give one impulse to the index-hand of the counter. As the card advances and the circuit is closed through the hole punched at "2" in the tens-column the contact-arms will be in contact with the contacts 2 of each group and the circuit will be closed through the brush 160, arm 154, contact 2 of group 152 and the coils of the magnet connected therewith, imparting one impulse to the index of the corresponding counter in group 150. The dials of the counters are suitably graduated, so that the number of impulses given to each counter-magnet may be read direct from the dials, and to obtain the total registration of the counters the reading of each dial is at the conclusion of the tabulation multiplied by the relative value of that particular counter. Thus the reading of the left-hand counter of group 150, one impulse of which represents ninety, is multiplied by ninety, the reading of the next counter by eighty, and so on, while in group 151 the left-hand counter reading is multiplied by nine, that of the next by eight, and so on, the products thus obtained being summarized to obtain the total of the tabulating operation.

In Fig. 12 I have illustrated diagrammatically an arrangement of devices embodying the registers or counters illustrated, described, and claimed in my United States Letters Patent No. 677,214, dated June 25, 1901. In this arrangement contact-arms 170 171 are mounted on a shaft 172 and are arranged to make a complete revolution at each operation of the machine and in such revolution to pass over the contacts 175 176. Each register, as described in my said patent, comprises a plurality of sector-plates 178 179, each carrying a group or series of electromagnets 181 182, similar in construction and arrangement to the magnets designated by the number 78 in said patent, to which reference is made for a detailed description. One contact-arm and one series of contacts are provided for each series or group of magnets. Indicators 183 and 184, one for each series of magnets, are mounted loosely on the shaft 172. Arms 185 are journaled on the shaft 172 and carry the indicator-actuating mechanism, as described in said patent, said arms being suitably connected to oscillate the indicator-actuating mechanism back and forth in front of the magnets at each operation of the machine. The contact-arms are insulated from the shaft 172; but it will be understood that it is not necessary that the contact-arms 170 171 should be mounted on this shaft so long as the arms make a complete revolution in synchronism with the movement of the card at each operation of the machine. Each of the contacts of the segment 175 is connected with the corresponding magnet of the series 181, and the contacts 176 are similarly connected with the magnets of the series 182. Each magnet of each series is independently connected to a common return-wire. The arm 170 is electrically connected with the brush 190 and

the arm 171 with the brush 191. When either of the brushes 190 191 contacts with the plate 113 through a hole punched in the card, the contact-arm connected with the brush will be in engagement with the contact which corresponds to said hole and the circuit will be closed through the corresponding magnet, releasing a pawl, which as the actuating mechanism is carried in front of the magnets will cause the actuating mechanism to engage its indicator, imparting to it an amount of movement corresponding to the index-point of the card. As will be understood, when using the apparatus illustrated in Fig. 12, the total results of the tabulation may be read directly from the indicator-wheels.

It is to be understood that a very wide departure may be made from the particular form and arrangement of the apparatus and devices herein described and illustrated without involving any departure from my invention, one particular feature of which is the operation of tabulating or sorting apparatus by means of a device such as a pair of electrical contacts, which are rendered operative at different points in the travel of the card, so that the operation of the apparatus will correspond with the position of the card relatively to that of the device controlled thereby.

It will be observed that one particular feature of my invention is the employment of a device, such as a pair of electrical contacts, rendered operative at different points in the travel of the record-card, so that the operation of the apparatus will correspond with the position of the card relatively to that of the device controlled thereby. It is also to be understood that other novel features of my present invention may be employed with other forms of controlling devices or contacts differently arranged and that my invention is not as to such other features necessarily restricted to the form or description of controlling devices or contacts illustrated in the drawings.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In apparatus for tabulating and sorting records, the combination with one or more groups of registers, of a device controlled by the records for actuating the registers in accordance with the position of a record relatively to the device controlled thereby, and a similar device also controlled by a record for effecting the delivery of the records at different points in accordance with the position of the record relatively to the last-mentioned record-controlled device.

2. In apparatus for tabulating record-cards, the combination with one or more groups of registers, of a record-controlled device for variably actuating the registers in accordance with the position of a record relatively to the record-controlled device when the latter operates.

3. In apparatus for tabulating record-cards having index-point positions arranged in columns, the combination of registers corresponding to the index-point positions, and a record-controlled device, common to each column of index-point positions, for actuating the registers in accordance with the relative position of the record and the actuating device when the latter operates.

4. In apparatus for tabulating record-cards having index-point positions successively arranged in columns, the combination of registers, a record-controlled device for variably actuating the registers in accordance with the position of the operative index-point, and means for feeding the cards to present the index-point positions of a column successively to said actuating device.

5. In apparatus for sorting record-cards having index-point positions successively arranged in columns, the combination of sorting mechanism, a record-controlled device for actuating the same, and means for feeding the cards to present the index-point positions of a column successively to said actuating device.

6. In apparatus for tabulating record-cards having index-point positions successively arranged in columns, the combination of a series of register-controlling electromagnets for each column of index-point positions, a card-controlled circuit-closing device common to the magnets of each series, and means for feeding the cards to present the index-point positions of a column successively to the circuit-closing device.

7. In apparatus for tabulating record-cards, the combination of a plurality of register-controlling electromagnets, a card-controlled circuit-closing device for said magnets, means for feeding the cards to present their index-point positions successively to said device, and a circuit-closing mechanism movable in unison with the card for bringing the magnets into circuit successively.

8. In apparatus for sorting record-cards according to the location of index-points thereon, the combination with card-feeding means, of a plurality of relatively immovable delivery-guides, one for each index-point position, means for moving said guides at each operation of the machine, and means for varying the extent of such movement according to the location of the index-point.

9. In apparatus for sorting record-cards according to the location of index-points thereon, the combination with card-feeding means, of a plurality of delivery-guides, connected to move together, means common to all the guides for moving them relatively to the path of the card at each operation of the machine, and means for arresting the move-

ment of the guides at a point determined by the location of the index-point on the card.

10. In apparatus for sorting record-cards the combination with card-feeding means, of a plurality of delivery-guides, means for oscillating said guides together at each operation of the machine, and means controlled by the index-point positions of the cards for arresting the movement of the guides at a point which will permit the delivery of the card which is in operative position to the guide which corresponds to the location of its index-point.

11. In apparatus for sorting record-cards the combination of a series of sorting-stations arranged in succession in the direction of movement of the cards, means for moving the cards in the direction of the sorting-stations, and means for terminating the movement of each card at a station, the distance of which from the operative position of the card is determined by the index-point thereon.

12. In apparatus for sorting record-cards the combination with card-feeding means, of a plurality of sorting-stations, and a traveling carrier which engages each card while moving from its operative position toward its station.

13. In apparatus for sorting record-cards, the combination with card-feeding means of a plurality of sorting-stations, means controlled by the card for determining which station shall receive the card, and a traveling carrier which engages each card while moving from its operative position toward such station.

14. In apparatus for sorting record-cards the combination of a plurality of card-receiving stations, guides leading from the operative position of the cards thereto, and mechanism moving along said guides to control the delivery of the cards to said stations.

15. In apparatus for sorting record-cards, the combination of sorting-stations arranged at progressively-increasing distances from the operative position of the cards, a plurality of movable guides, one for each station, of progressively-increasing length, and means controlled by the cards for moving a variable number of said guides across the path of movement of the cards to determine which guide shall receive the card.

16. In apparatus for sorting record-cards having index-point positions thereon, the combination with card-feeding means of card-sorting stations corresponding to the index-point positions on the cards, a plurality of relatively immovable guides of progressively-increasing length communicating with said stations and means for delivering each card to the guide which corresponds to the position of the index-point thereon.

17. In apparatus for sorting record-cards, the combination with card-feeding means, of a plurality of sorting-stations, guides communicating with said stations, means for delivering the cards to the guides, and means for engaging the cards to control their movement in the guides.

18. In apparatus for sorting record-cards, the combination with card-feeding means, of a plurality of sorting-stations, a card-guide for each station, means controlled by the card for determining which guide shall receive the card, and a device common to all the guides for controlling the movement of the cards therein.

19. In apparatus for sorting record-cards, the combination with card-feeding means, of a plurality of sorting-stations, guides communicating therewith, and a movable card-engaging device common to all the guides for controlling the movement of the cards in the guides.

20. In apparatus for sorting record-cards, the combination with card-feeding means, of a plurality of sorting-stations, guides communicating therewith and traveling fingers arranged to engage each card in its appropriate guide and control its movement therein.

21. In apparatus for sorting record-cards, the combination with card-feeding means, sorting-stations and guides, of mechanism for controlling the movement of the cards in the guides comprising an endless carrier, revoluble supports therefor and card-engaging fingers.

22. In apparatus for sorting record-cards, the combination with card-feeding means, sorting-stations and guides, of mechanism for controlling the movement of the cards in the guides, comprising an endless carrier, revoluble supports upon which the carrier is mounted, card-engaging fingers, and means for revolving said supports.

23. In apparatus for sorting record-cards, the combination with card-feeding means, of a plurality of sorting-stations, a plurality of card-receiving guides, a connecting device common to all the guides through which they are moved into receiving position, and card-controlled means for determining the movement of said connecting device.

24. In apparatus for sorting record-cards, the combination with card-feeding means, of a plurality of sorting-stations, a plurality of card-receiving guides corresponding to the stations, a connecting device common to all the guides through which they are moved into receiving position, means for actuating said connecting device and card-controlled means for arresting the movement thereof at a point determined by the index-point of the card.

25. In apparatus for sorting record-cards, the combination with card-feeding means, of a plurality of sorting-stations, guides and means common to all the guides and controlled by the record-cards for determining which guide shall receive the card.

26. In apparatus for sorting record-cards, the combination with card-feeding means, of a plurality of sorting-stations, card-receiving guides, and an electromagnet common to all the guides for determining which station shall receive the card.

27. In apparatus for sorting record-cards, the combination with a plurality of sorting-guides corresponding to the index-point positions on the cards, means for moving the card and guides in unison and means for arresting the movement of the guides as the index-point on each card reaches its controlling position.

28. In apparatus for sorting record-cards, the combination with a plurality of sorting-guides corresponding to the index-point positions on the cards, means for moving the cards and guides in unison, and means comprising an electromagnet for arresting the movement of the guides as the index-point on each card reaches its controlling position.

29. In apparatus for sorting record-cards, the combination of sorting-guides corresponding to the index-point positions on the cards, a circuit-controlling device common to all the index-points of each column, means for feeding the cards and moving the guides in unison, and means for arresting the movement of the guides as the index-point reaches its controlling position.

30. In apparatus for sorting record-cards, the combination of sorting-guides corresponding to the index-point positions on the cards, a circuit-controlling device common to all the index-point positions of each column, means for adjusting said device in operative position for any column on the card, and means controlled by said device for delivering each card to its proper sorting-station.

31. In apparatus for sorting record-cards, the combination with card-feeding means, of a plurality of guides corresponding to the index-point positions on the cards, means for moving said guides relatively to the path of the cards, an engaging device for arresting the movement of the guides, and means, such as an electromagnet, controlled by each card, for actuating the engaging device, when the guides are in a position which corresponds to the index-point on the card.

32. In apparatus for sorting record-cards, the combination with feeding and delivering mechanism, of a card-controlled electric circuit comprising normally closed contacts which are separated by the passage of the cards between them, and means controlled by said contacts for sorting the cards into groups.

33. In apparatus for sorting record-cards, the combination with feeding and delivering mechanism of a card-controlled electric circuit having a fixed contact common to a plurality of the columns of index-point positions on the card, and a contact which is adjustable along the fixed contact to bring it into operative relation with any one of said columns.

34. In apparatus for sorting record-cards, the combination with card-feeding means, of a plurality of sorting-stations, a card-receiving guide for each station, an operating connection common to all the guides, an electromagnet for controlling the movement of said connection, and a circuit-controlling device for said magnet under the control of the card.

35. In apparatus for sorting record-cards according to the location of an index-point thereon, the combination with card feeding and delivering means of mechanism variably controlled by a record-controlled device common to the index-point positions of each column, for effecting the proper delivery of the cards.

36. In apparatus for sorting record-cards, the combination of a plurality of sorting-stations, a single record-controlled device common to a plurality of the stations and means for effecting the delivery of each card at a station which is determined by the relative positions of the card and the record-controlled device when the latter operates.

37. In apparatus for sorting record-cards, the combination of a single circuit-controlling device common to a plurality of the index-point positions in any group of the record-cards, and means for effecting the delivery of each card at a point which is determined by the relative positions of the card and the circuit-controlling device when the latter operates.

38. In apparatus for sorting record-cards, the combination of a plurality of sorting-stations, a card-controlled device common to all the stations, and means controlled thereby for effecting the delivery of a card at a station which is determined by the relative positions of the card and the card-controlled device when the latter operates.

39. In apparatus for sorting record-cards, the combination with card feeding and delivering means, an operating-circuit which includes an electric motor and contacts controlled by the motor for breaking the circuit at a predetermined point in the movement of the cards, and circuit-closing devices actuated by the movement of the card for closing the operating-circuit around the motor-controlled contacts when the card is in said predetermined position.

40. In apparatus for sorting record-cards, the combination with card feeding and delivering means, of a contact in the motor-circuit actuated by the motor to break the circuit when a card is in a predetermined position and two circuit-closing devices in series arranged to be actuated simultaneously by the movement of the card to close the motor-cir-

cuit around the motor-actuated contact when the card is in said predetermined position.

41. In apparatus for sorting record-cards, the combination with card feeding and delivering means and an operating-motor, of an electric circuit, contacts therein controlled by the cards, and devices actuated by the motor for breaking the circuit at another point after each card has passed its operating position.

42. In apparatus for tabulating record-cards, the combination with a record-card having index-point positions arranged in columns, each index-point position of a column representing a different characteristic or amount, of registering mechanism, a record-controlled device which is common to all the index-point positions of a column, means for presenting the index-point positions of a column successively to their record-controlled device and means controlled by the record-controlled device for variably actuating the registering mechanism in accordance with the position of a record relatively to the record-controlled device when the latter operates.

43. In apparatus of the character described the combination with a record-card having index-point positions, a contact device controlled by the record and common to a plurality of index-point positions, means for feeding the record-card to present the index-point positions of a column successively to their contact device, registering members controlled by said contact device and means for imparting a variable movement to the registering members in accordance with the relative position of the record-card and said contact device when the latter operates.

44. In apparatus of the character described the combination with a record-card having index-point positions arranged in columns, contact devices each of which is common to all the index-point positions of a column, means for relatively moving the record-card and contact device to present the index-point positions of a column successively to their contact device, register mechanism comprising a plurality of movable registering members or indicators, each of which is controlled through a single contact device and means for variably moving the registering or indicating members, the extent of such movement being determined by the location of the operating index-point in its column.

45. In apparatus of the character described the combination with a record-card having index-point positions arranged in columns, each position of a column representing a different characteristic or amount, record-controlled devices each of which is common to all the index-point positions of a column, means for relatively moving the record-card and the record-controlled devices to present the index-point positions of a column successively to its record-controlled device, register mechanism comprising a plurality of members or indicators each corresponding to a column of index-point positions and movable into different positions and means controlled by the record-controlled devices for moving each register member or indicator into a position which corresponds with the location of the operating index-point in its column.

46. In apparatus of the character described the combination of a motor, registering members or indicators, a record-card having index-point positions, means for moving the record-card in unison with the motor, a record-controlled device common to a plurality of index-point positions for effecting the connection of each registering member or indicator with the motor and means for maintaining such connection for a variable period the length of which is determined by the location of the operating index-point.

47. In apparatus of the character described the combination of a motor, registering members or indicators, a record-card having index-points, contact devices which are operated by the record-card at different points in its movement, means for moving the record-card between said contacts in unison with the motor, means comprising electromagnets controlled by the contact devices for separately connecting each registering member or indicator with the motor and means for maintaining such connection for a variable period the length of which is determined by the location of the operating index-point.

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REGISTERING APPARATUS FOR TABULATING SYSTEMS.

APPLICATION FILED AUG. 17, 1905.

945,236.

Patented Jan. 4, 1910.

3 SHEETS—SHEET 1.

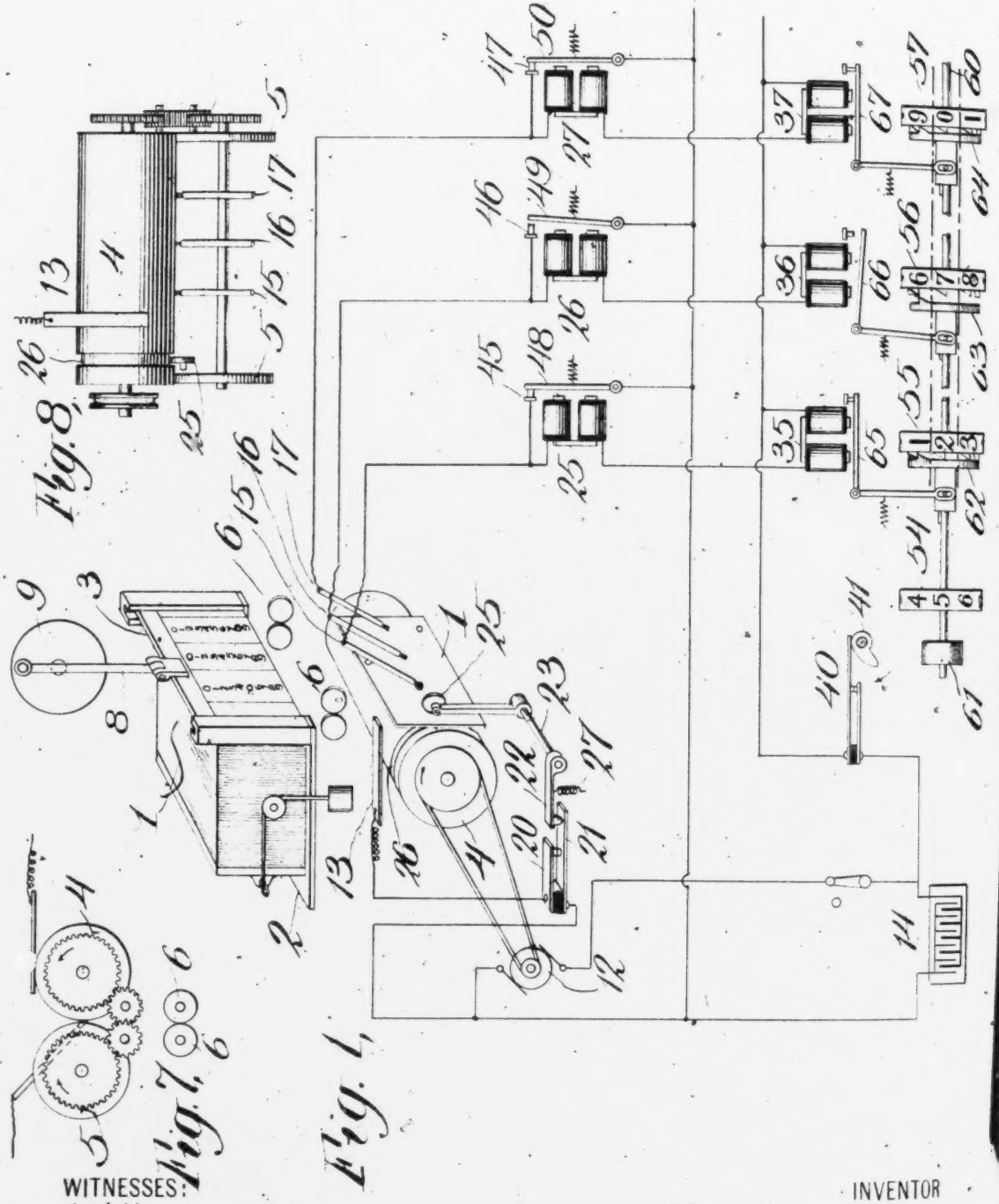

Fig. 8.

Fig. 7.

Fig. 1.

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3 SHEETS—SHEET 2.

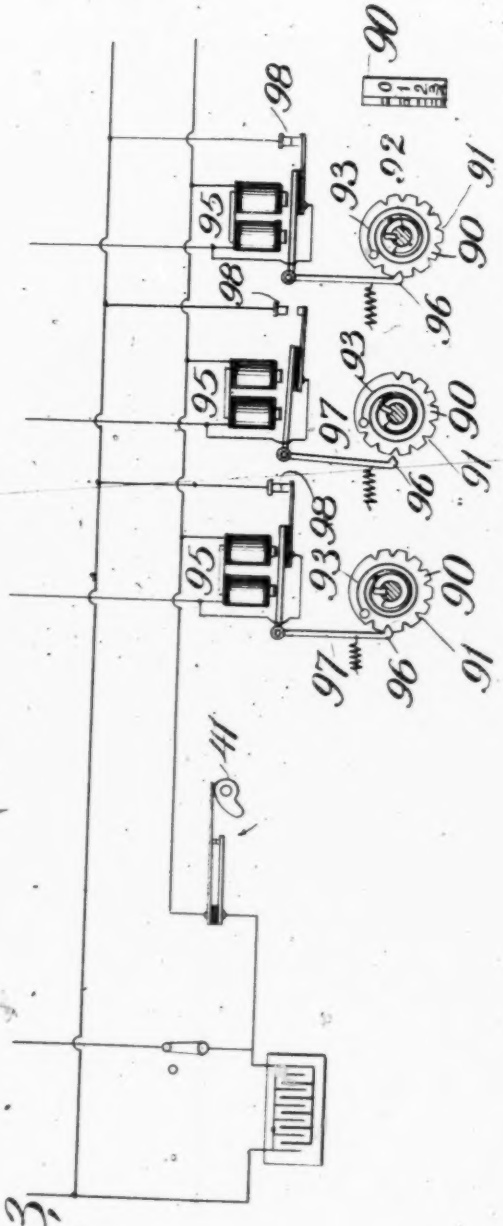

Fig. 3.

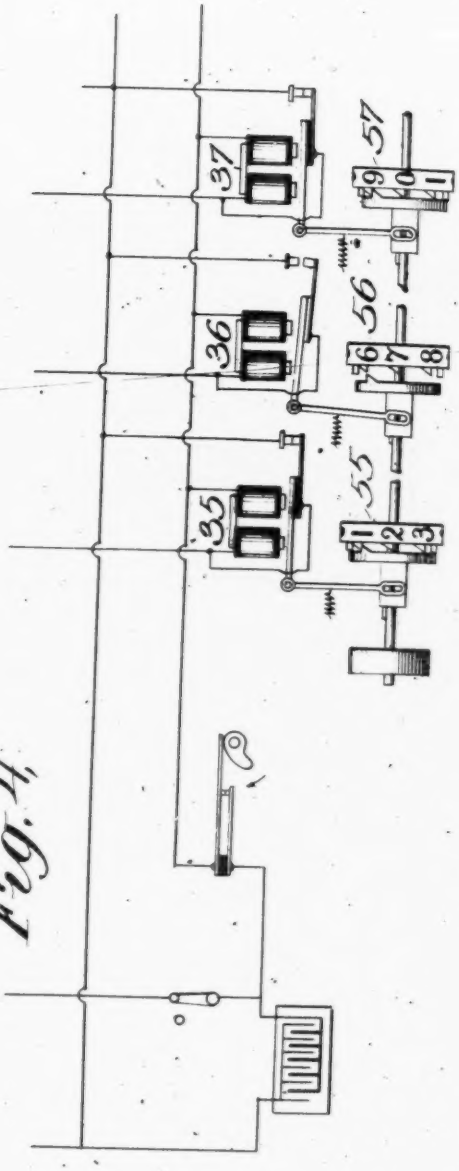

Fig. 4.

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Patented Jan. 4, 1910.

3 SHEETS—SHEET 3.

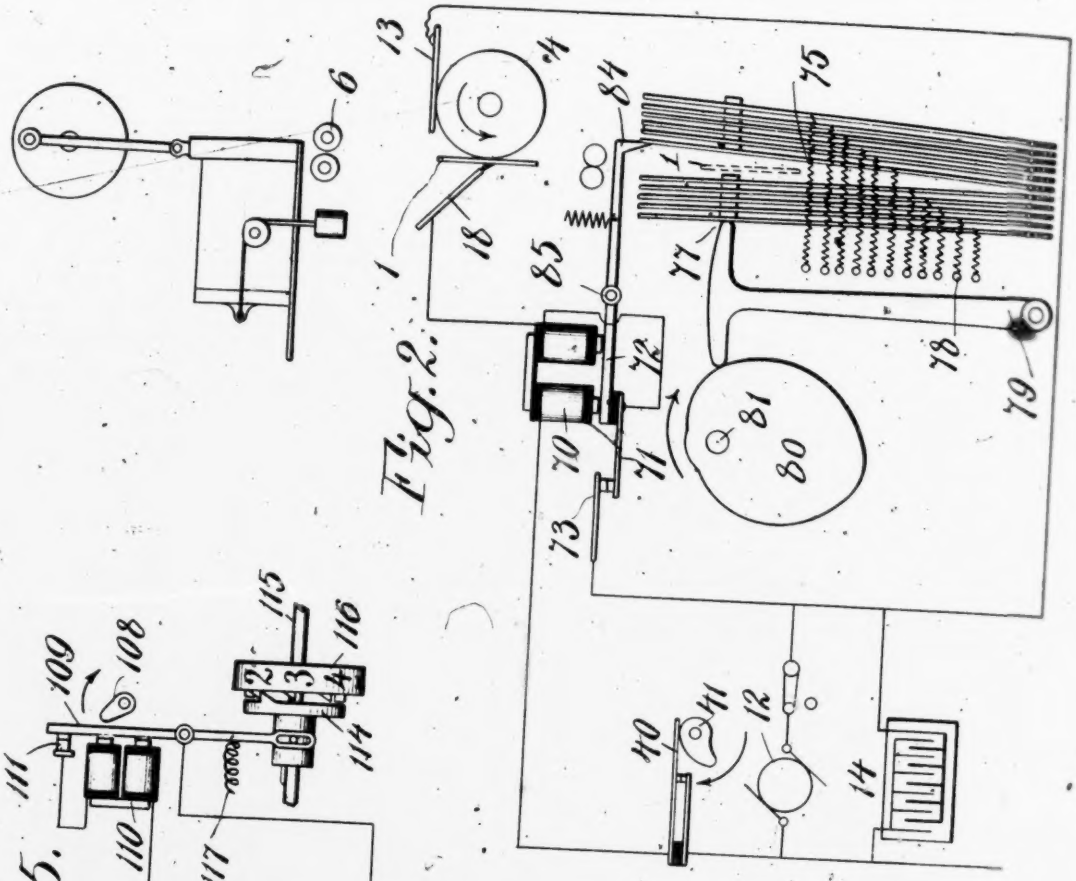

Fig. 2.

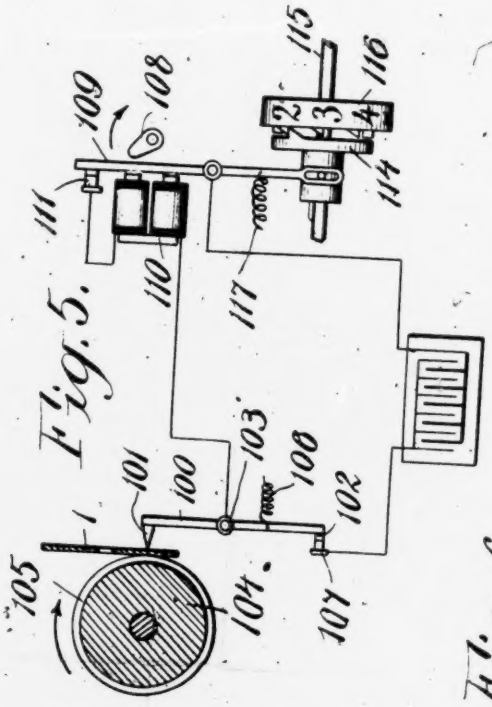

Fig. 5.

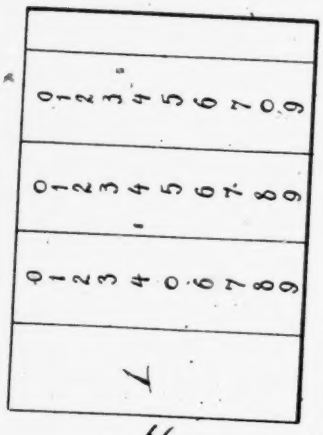

Fig. 6.

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HERMAN HOLLERITH, OF GARRETT PARK, MARYLAND, ASSIGNOR TO THE TABULATING MACHINE COMPANY, A CORPORATION OF NEW JERSEY.

REGISTERING APPARATUS FOR TABULATING SYSTEMS.

945,236. Specification of Letters Patent. Patented Jan. 4, 1910.

Application filed August 17, 1905. Serial No. 274,641.

To all whom it may concern:

Be it known that I, HERMAN HOLLERITH, a citizen of the United States, and a resident of Garrett Park, Montgomery county, Maryland, have invented certain new and useful Improvements in Apparatus for Use in Tabulating Systems, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification.

The object of this invention is to provide means for operating registering and other apparatus used in the Hollerith tabulating system in which is employed a record card having index-points, preferably punched holes, which are located on each particular record card in accordance with the data which that card represents. The system, of which these record cards form a distinguishing characteristic, comprises apparatus for registering the items constituting the record formed on each record card and totalizing or integrating the items of any desired number of the record; apparatus for indicating, without totalizing, the record on each card; apparatus for sorting or classifying the record cards into groups; apparatus for verifying the accuracy of the record on each card by rejecting or separately grouping such records as may contain inconsistent or incongruous items and other apparatus for performing analogous or incidental operations in the complete tabulation of the records.

The operation of the apparatus above referred to is all variably controlled by the record cards and the result of each operation thereof depends on the particular record on the card which is then in control of the apparatus, and I have therefore hereinafter in referring to such apparatus, whether employed for integrating, sorting or verifying the records, for indicating the items of a record or for the other purposes referred to, described it generically as apparatus adapted to be operated according to the location of the index points on the record card.

My invention comprises the use of a record such as described, and in which the index-point positions are arranged in column, a record-actuated device, such, for example, as a pair of electrical contacts, common to all the index-point positions of a column, which are put in action by the index-point, an operating circuit initially controlled by the record-actuated device or contacts, and means for holding such circuit under control for a variable period during each cycle of the machine, the duration of which is determined by the location of the index-point in its column. Electricity is the agent preferably employed for effecting the control or operation of the apparatus but it is not my intention to restrict my invention to the employment of that particular operating or controlling agent since other equivalent means may be employed instead of an electric circuit or circuits and electrically operated devices hereinafter described; but I consider electricity to be the most advantageous agent and have therefore selected, for the purpose of description, an electrically operated apparatus, and in this connection it is to be understood that where electricity is employed as an actuating or controlling agent the apparatus may be arranged for operation either on open or closed circuits.

My invention also comprises an apparatus of the character referred to, actuated by means of a record-card with index-point positions arranged in column, having a record-actuated device common to the index-point positions of a column, registering, indicating or sorting devices and an electro-magnet for controlling their operation which is held under control for a variable period during each cycle of operation of the apparatus.

My invention, in its specific relation to the registering and indicating apparatus referred to, also comprises means for starting the movement of the registering or indicating members and means for stopping such movement, one of said means being actuated when the record-actuated device is actuated by its index-point and the other of said means being actuated at a fixed point in the movement of the record, whereby a variable movement is imparted to the registering or indicating member, the extent or duration of which is determined by the location of the index-point on the record, which is moved relatively to the record-actuated device.

In the accompanying drawings, Figure 1 is a diagrammatic view, (shown partially in perspective), of my invention arranged to operate registering devices; Fig. 2 is a similar view showing my invention arranged for sorting or grouping the records; Fig. 3 is a partial diagram showing indicating devices; Fig. 4 is a similar diagram showing a modification of the arrangement illustrated in Fig. 1; Fig. 5 is a diagrammatic view showing a modification of the record-actuated contacts and circuit; Fig. 6 is a view of a record card on a larger scale; Fig. 7 is a detail end view of the card feeding and contact mechanism and Fig. 8 is a plan view thereof.

Similar reference characters are employed to designate like parts in all the views.

In the form of record-card which I have selected for the purpose of illustrating and describing my invention, but without intending to limit my invention thereto, the index-point positions, as shown in Fig. 6 are denoted by printed figures arranged in groups, each group consisting of one or more columns of figures comprising the nine digits and a cipher substantially as shown in my U. S. Letters Patent No. 777,209, with the cipher, (except in Fig. 5), at the top of each column in horizontal alinement and the digits following in order down each column to the figure 9. To secure brevity in this description I have shown only three columns of index-point positions, it being assumed that each card contains a record of value or of amount which does not exceed one thousand, but this theoretical form of record will enable the principle of operation of my present invention to be readily understood. In Fig. 1 I have illustrated my invention in a simple form adapted to integrate these records and to operate electrically.

Referring for the present to Fig. 1, a sufficient number of the records 1 are placed on edge, with the cipher at the top, upon a suitable platform 2 and are fed one by one to the action of the record-actuated contacts, to be presently described, by a reciprocating cross head 3, rotating drum 4, feed rollers 5 and, if desired, supplemental feed rollers 6. As this feeding mechanism may be substantially similar to that shown and described in my U. S. Letters Patent No. 685,608, dated October 29th, 1891, further description thereof in this specification is unnecessary except to state that the cross head 3 is reciprocated by a connecting rod 8 actuated by the crank disk 9 which is constantly driven in synchronism with the feed rollers, rotating drum 4 and other parts of the apparatus hereinafter referred to, by a suitable motor 12. The drum 4, as shown in Fig. 1, is made of conducting material and forms one terminal of an electric circuit, current being conveyed thereto by the conducting brush 13, which is connected with a suitable source of energy such as the battery 14. Conducting brushes 15, 16 and 17, insulated from each other are supported adjacent to the drum 4 so that their flexible ends, which are normally in contact therewith, are separated therefrom when a card is fed down between them and the drum. Each of the conducting brushes (15, 16, 17), forms, with the conducting drum 4, a pair of electrical contacts which are actuated, or permitted to come together and move apart, by the record, and I therefore, for the sake of brevity, refer to each pair of these contacts as record-actuated contacts. The right hand column of index-point positions on the cards represents units, the middle column tens and the left hand column hundreds and to transfer an item, say the number 508 to the card, a hole is punched in the left hand column at the position denoted by the figure 5; in the middle column at the position denoted by the cipher and in the right hand column at the position denoted by the figure 8. When the card is fed down between the brushes and drum the index-point positions of each column, each of which represents a different characteristic or amount, are presented successively to the brushes or record-actuated devices, and when the punched hole in a column registers with the brush for that column, the brush will contact with the drum and an electrical contact will be established momentarily. The time at which the record-actuated devices are thus actuated to establish such contact, depends upon the location of the punched hole constituting the index-point, and in order that the circuit shall be established initially only through these contacts I provide a contact which will hold the circuit open at another point at all times when no card is between the drum and the brushes, as for instance during the period that elapses between the passage of successive cards. This contact is preferably, but not necessarily, actuated by the card itself and as shown it consists of the opposed spring-contact-arms 20 and 21 tending to close the circuit. A spring-depressed rock arm 22 engages the contact arm 21 and is secured to the rock shaft 23, to which is also secured an arm 24, carrying the roller 25. The roller 25, when no card is in position between the brushes 15, 16 and 17 and the drum 4, is held lightly in the groove 26 on the drum by the spring 27, and the arm 22 will hold the contacts 20 and 21 separated, but when a card is fed down it will pass between the drum 4 and the roller 25 forcing the latter out of the groove 26, raising the arm 22 and permitting the contacts 20 and 21 to come together to close the circuit.

Still referring to the particular form of apparatus illustrated in Fig. 1, each of the

brushes 15, 16 and 17 is separately connected in circuit with one of the relay magnets 25, 26 and 27. The magnet 25 is connected with a magnet 35, the magnet 26 with the magnet 36 and the magnet 27 with the magnet 37. The magnets 35, 36 and 37, which I may designate as control magnets to distinguish them from the relay magnets, are connected to the return wire through the contacts 40. The contacts 40 are arranged to be separated to break the circuit simultaneously through all the magnets, by a constantly revolving cam 41, at the instant the advancing movement of the card brings the index-point positions, denoted by the ciphers, under the brushes 15, 16 and 17. Each of the contacts 45, 46 and 47 is connected in series with one of the relay magnets and with its connected control magnet and each of the armatures 48, 49 and 50 of the relay magnets is separately connected to the opposite side of the line, so that when a circuit is established through any of the relay and control magnets by the card-actuated contacts, which are closed only momentarily, the armature of the relay magnet will be attracted to its contact, closing a circuit at that point which will include the coils of the relay and control magnets and such circuit will be held closed, after the record-actuated contacts are separated, until it is broken by the cam 40 at the instant the zero index-point positions on the advancing record are under the brushes.

The specific devices adapted to be operated according to the location of the index-points on the record card which I have illustrated in Fig. 1 comprise a register wheel or member and suitable driving means therefor, such as a clutch disk. Three such register wheels, 55, 56 and 57 are illustrated in Fig. 1 which is intended to illustrate a typical form of registering apparatus; but their number may of course, be varied, as desired. Any desired form of registering apparatus embodying directly actuated registering members with means for carrying or transferring from one member to that of the next higher order, accumulating members and zero resetting devices may be employed, and I have therefore not considered it necessary to illustrate or describe the same in detail since their construction and operation are well understood by those skilled in the art.

In the registering apparatus, 54 represents the thousands wheel which is an accumulating wheel actuated only by the transfer mechanism, 55 indicates the hundreds wheel, 56 the tens wheel, and 57 the units wheel, and the wheels are provided with a suitable sight opening, (indicated by dotted lines), through which only one number of each wheel is exhibited. Each wheel is mounted loosely on the shaft 60 which is constantly driven at a uniform speed by the pulley 61, suitably connected to the motor 12, in synchronism with the moving card. The wheels are suitably supported so that the turning movement of the shaft 60 will not actuate the wheels until they are brought into positive connection therewith. Each of said wheels is provided with a series of peripheral numbers from 0 to 9, and in the form of apparatus illustrated this connection of the wheels with the shaft 60 is effected by means of a clutch, comprising a series of clutch teeth, one for each figure, on the wheels, and coöperating clutch members or disks 62, 63 and 64, splined on the shaft 60 so that they will slide on the shaft and turn therewith. These clutch members 62—64 rotate constantly in one direction during the operation of the machine, thus avoiding any reversal of movement and permitting the operation of the apparatus at high speeds and without objectionable vibration. Each clutch disk is provided with a clutch tooth which will engage a clutch tooth on its registering wheel when it is moved toward the wheel, locking the wheel and disk together so that the wheel will turn with the disk. The spring-retracted armatures 65, 66 and 67 of the control magnets are in the form of bell cranks and the depending arm of each bell crank is suitably connected to the hub of one of the clutch disks 62, 63 and 64. When any one of the control magnets is energized its armature will be attracted toward the magnet and the movement of the armature will carry the clutch disk connected therewith into locking engagement with its registering wheel. This engagement will be established by the closing of the circuit by the record-actuated contacts and will be maintained, after the record-actuated contacts are separated, by the circuit established through the relay contact until the circuit is broken at the contacts 40 by the cam 41. The shaft 60 is arranged to make one complete revolution while the index-point positions of a card pass under the brushes 15, 16 and 17. As will be understood the form and arrangement of the wheel-engaging devices or clutches, are susceptible of modification, and I employ the term "clutches" in a broad sense as descriptive of any suitable connecting mechanism.

The operation of the apparatus illustrated in Fig. 1 is as follows: The punched cards being properly placed on the platform 2, the motor 12 is started and the cards are fed down so as to pass between the drum 4 and the brushes 15, 16 and 17. At the instant the lower edge of the card passes between the drum and the brushes the wheel 25 is, by the card, forced out of the groove 26 closing the contacts 20 and 21. Assuming that the record card denotes an item of 508 to be added to the total shown by the registering wheels, as the card advances the circuits between the drum and the brushes will all remain open until the index-

point 8 in the units column reaches the brush 17 when the latter will contact with the drum through the punched hole, closing the circuit through the magnets 27 and 37 and throwing the revolving clutch disk 64 into engagement with the register wheel 57. The control of the register wheel by the magnet 37 thus established through the card contacts is maintained, notwithstanding the momentary duration of the contact between the brush and the drum through the moving hole on the card, by the simultaneously established circuit, formed by the contacting of the relay armature 50 with the contact 47, through the coils of the magnets 27 and 37, the contacts 40 to the battery and back to the relay armature 50. When the 5 index-point in the hundreds column reaches its brush 15, the clutch disk 62 will be similarly actuated to impart the motion of the shaft 60 to the register wheel 55. The record under consideration will not close a circuit through the control magnet 36, because the cipher is punched in this column, and the circuit will be broken at the contacts 40, by the cam 41 when the cipher or zero index-point positions reach the brushes, and therefore the only movement imparted to the register wheel 56 will be that due to the transfer or carrying mechanism. When the circuit is broken at the contacts 40 the armatures 65 and 67 are released and the clutch disks 62 and 64 are drawn out of engagement with the registering wheels, which stop at this point in their movement. To each register wheel has been imparted a movement which corresponds with, and is determined by, the location of its index-point on the record card. Thus the wheel 57 will be rotated eight-tenths of one revolution or while 8 of the 10 index-point positions of the column pass under the brush, while the wheel 55 will be rotated five-tenths of one revolution or while five index-point positions are passing under the brush, so that 8 will be added to the units wheel, nothing to the tens wheel, except by the transfer mechanism, and 5 to the hundreds wheel. As the record passes from under the brushes it is deposited in a suitable receptacle, another record is presented and the action is repeated.

The form of apparatus embodying my invention which I have illustrated in Fig. 2 does not differ in its principle of operation from the apparatus hereinbefore described. The card feeding mechanism and card contacts are substantially alike in both forms of apparatus and require no further description. The devices adapted to be operated according to the location of the index-points comprise a plurality of movable guides for delivering or controlling the delivery of the record cards to different points so that the records are sorted or grouped according to their index-points. Any scheme of sorting may be employed which is desirable in handling the records either before or after tabulation. The apparatus as shown is intended to sort the cards according to the location of the index-point in the hundreds column, the cards on which the item recorded is less than one hundred being delivered in one group, those on which the item between ninety-nine and two hundred being delivered in another group and so on. I have also illustrated in Fig. 2 a modification in the means for maintaining the control of said devices in which the relay magnet is dispensed with and the control of the control magnet 70 is maintained by means of a contact 71 actuated by the movement of the armature 72 to engage with a contact 73 to hold the circuit through the magnet closed after the separation of the card contacts. The sorting guides 75 are mounted directly below the card-actuated contacts and are so constructed that the ends of the guides, which are held apart by the separators 77, may be reciprocated across the path of the cards. The guides are movable separately with relation to each other but are yieldingly held to move in unison by springs 78 one of which is secured to each guide and which tend to move the guides to the left. The upper ends of the guides may be pivoted or they may be made of flexible material to permit the requisite reciprocating movement. The left hand guide of the series rests against a rock arm 79 which is engaged by a rotating cam 80 on the shaft 81 driven by the motor 12 and so arranged as to make one complete revolution for each card passing between the card contacts. As a card reaches the brush 18, (only one brush being employed in this modification), the cam 80 will be in the opposite position to that shown, with its longest radius to the right of the shaft and the guides will all be held to the right of the path of the descending cards and against the rock arm 79 by the springs 78. The rock arm 79 is pivoted to swing freely so as to follow the surface of the cam under the action of the springs. As the card descends the cam 80, which is arranged to revolve synchronously, permits the springs to draw the guides across the path of the card so that when the 9 index-point position of the card is under the brush the first guide, (from the left), will be just under the latch 84 which forms an extension of the armature 72 pivoted at 85, and when the zero index-point position of the card reaches the brush, (assuming that none of the intermediate points are punched), the tenth guide, (from the left), will be under the latch 84, the intermediate positions of the guides and card corresponding at all times. If a punched record card be fed between the card contacts, as for ex-

ample the card heretofore described and punched as shown in Fig. 6. the brush 18 will traverse the index-point positions of the left hand column and when the 5 index-point position, (which has been punched), reaches the brush, the fifth guide. (from the left), will be approximately under the latch 84. At this instant the circuit will be closed by the brush 18 through the coils of the magnet 70 attracting the armature and carrying the latch 84 down into the space between the fifth and sixth guides, holding back or arresting the movement of all the guides on the right while the fifth guide and all on the left of it will continue their movement. This separates the fifth and sixth guides sufficiently to permit the card to enter the space freely and by the guides the card is conducted to a suitable receptacle in which all cards similarly punched in the hundreds column will be deposited. The cam 80 is of course, to be given the proper form to actuate the guides to receive the proper card, such form depending upon the distance between successive cards and the distance between the operative position of the cards and the tops of the guides. When the armature 72 is attracted toward the magnet 70 the contact 71 carried thereby will engage the contact 73 and close a circuit through the battery, contacts 40, magnet 70 and contact 71, thus holding the guides separated until after the zero point positions on the index cards pass the brush, when the cam 41 will break the circuit, releasing the armature and carrying the latch 84 out of engagement with the guides which will all be carried back to their initial position by the cam 80, ready for another operation. Any number of sorting guides up to the maximum number of controlling index-point positions on the cards may be employed; for instance if it be desired to separate the cards into two groups only two guides or a deflector for guiding the cards into either of two receptacles would be required.

In Fig. 3 I have illustrated a modification of my invention employing substantially the same means for maintaining the control of the control magnets as is shown in Fig. 2. In this modification each of the devices adapted to be operated according to the location of the index-point on the record cards comprises an indicating wheel and driving means therefor, by which the item or record on a card is simply indicated and which is then automatically reset at zero. The indicating wheels 90, of which three are shown, bear peripheral figures or other characters corresponding to the index-point positions on the card. As shown these characters may consist of the figures from 0 to 9. A notch 91 is formed on each wheel for each character and the wheels are loosely mounted on a shaft which is given one complete revolution for each card. The wheels are secured to the shaft 92 by a spring 93 which is secured at one end to the shaft and at the other end to the wheel so that, unless restrained, each wheel turns with the shaft, while if the wheel be held against movement the shaft will turn independently of the wheel and when the wheel is released it will return to its initial or zero position. When the circuit through any of the magnets 95 is closed by the card contact, its armature will be attracted to the magnet, carrying the detent 96 on the arm 97 secured to the armature, into one of the notches on the wheel and hold the wheel in position to show through the sight opening that character on the wheel which corresponds to the index-point by which the circuit was closed. The magnet is maintained under control, with the wheel in its arrested position, by a circuit established by the contacts 98 until the zero index-point positions of the record have passed the contact brushes, of which three are employed as shown in Fig. 1. The circuit is then broken by the cam 41 and the wheels are set to zero position by the spring 93, which has been placed under tension by the movement of the shaft 92 after the locking of the wheel by the detent.

In Fig. 4 is illustrated a modification of Fig. 1 in which the relay magnets 25, 26 and 27 are dispensed with and the contact for closing the circuit, to maintain the control of the control magnet, is carried by the armature of the latter.

Although I prefer to employ electric circuits for the purpose of operating and controlling the devices adapted to be actuated according to the location of the index-points on the record card because many obvious advantages are secured thereby, I do not intend to exclude the use of equivalent operating or controlling means or circuits, nor to restrict the circuit or circuits to circuits which are closed to effect the operation of the devices, since it is obvious that the operating circuit or circuits may be held under control while open or closed; nor is it essential, although I deem it desirable, that where a circuit is controlled by the record card, it should be actually closed through the card even where the operating or controlling circuit are electric circuits, and as indicating how widely the details of the circuits, connections and operating means may be modified without departing from the spirit of my invention I have illustrated in Fig. 5 a possible modification of the apparatus illustrated in Fig. 4, in which the contact for establishing a circuit to maintain the control of the devices to be operated is actuated directly by the armature of the control magnet. In this modification a lever 100, having on one end a tapering point 101 and carrying at its oppo-

site end a contact 102, is mounted on the pivot 103, adjacent to the rotating drum 104. I have shown only one lever but it will be understood that, with the arrangement indicated, there would be one lever for each column of index-point positions. The drum 104 which is not in circuit is provided with circumferential grooves 105, one for each column of index-point positions, and the spring 106 tends to hold the point 101 in the corresponding groove on the drum with the contacts 102 and 107 separated. When a punched card is fed between the point 101 and the drum 104 it will swing the lever 100 to close the contacts 102 and 107, as shown, until the hole in the card reaches the point 101 when the latter will enter the groove 105 through the hole, swinging the lever 100 sufficiently to open the contacts 102 and 107 momentarily until the advancing card forces the point out of the groove and closes the contacts. In this modification the cards are fed so that the index-points will pass under the point 101 in the opposite order from that heretofore described, that is to say, the position of the cards or their feeding movement is reversed so that the zero position will pass under the point 101 first and the 9 position last. A revolving cam 108 which operates in synchronism with the card feeding means is arranged to move the armature 109 of the magnet 110 into engagement with the contact 111 at the instant the zero position of such card reaches the position 101. This movement of the armature causes the clutch disk 114 on the constantly rotating shaft 115 to engage the register wheel 116 and rotate the latter. The contacts 102 and 107 having been closed by the advancing card just before the cam 108 moves the armature 109, this movement of the armature completes the circuit through the magnet and the circuit is maintained by the magnet after the cam moves out of engagement with the armature until the magnet circuit is broken at the contacts 102 and 107 and the armature released by the movement of the lever 100 when the point 101 enters the hole in the card. When the circuit is thus broken the spring 117 draws the clutch disk out of engagement with the latter and the movement of the latter is arrested. As the shaft 115 makes one complete revolution while the index-point positions on the card are passing under the point 101, as heretofore explained, the register wheel will be turned one number for each index-point position passing under the point from zero when the wheel commences to turn, until the punched hole reaches the point when its movement ceases.

While for the purpose of illustrating and clearly describing my invention, I have selected certain specific means and forms of apparatus in which it is embodied, it is to be understood that the same may be modified in many respects without departing from the principle or spirit of the invention as set forth in the claims.

I claim:

1. In apparatus of the character described, the combination with a record card having index-point positions in column, of a record-actuated device common to the index-point positions of a column, an operating circuit and means for holding said circuit under control for a variable period during each cycle of operation, the duration of which is determined by the location of the index-point on the controlling record.

2. In apparatus of the character described, the combination with a record card having index-point positions in column, of a record-actuated device common to the index-point positions of a column, an electric circuit and means for holding said circuit under control for a variable period during each cycle of operation, the duration of which is determined by the location of the index-point on the controlling record.

3. In apparatus of the character described, the combination with a record card having an index-point, of an electric circuit, means actuated by the index-point for establishing the control of said circuit and means for maintaining such control independently of the means for establishing the same.

4. In apparatus of the character described, the combination with a record card having an index-point, of an electric circuit, record-actuated contacts for closing said circuit by means of an index-point, and means for maintaining a circuit around the record-actuated contacts when the latter are open.

5. In apparatus of the character described, the combination with a record card having an index-point, of an electric circuit, record-actuated contacts for controlling said circuit by means of an index-point and means for controlling a circuit around the record-actuated contacts after the latter have been actuated by an index-point.

6. In apparatus of the character described, the combination with a record card having an index-point, of an electric circuit, record-actuated contacts for controlling said circuit by means of an index-point, means for establishing the control of a circuit around the record-actuated contacts, means for maintaining such control after the record-actuated contacts are operated, during a variable period which is determined by the location of the index-point on the record card.

7. In apparatus of the character described, the combination with a record card having an index-point, of an electric circuit, record-actuated contacts for controlling said circuit by means of an index-point, means actuated at a time determined by the

location of the index-point for establishing the control of a circuit around the record-actuated contacts and means actuated independently of the index-point for terminating such control, whereby the location of the index-point determines the period of such control.

8. In apparatus of the character described, the combination with a record card having an index-point, of an electric circuit, record-actuated contacts for closing said circuit by means of an index-point, means for maintaining a circuit around the record-actuated contacts when the latter are open and means actuated independently of the record for opening the circuit.

9. In apparatus of the character described, the combination with a record card, having an index-point, an electric circuit, devices adapted to be operated according to the location of the index-point on the record card, an electromagnet in said circuit, means actuated by the index-point for controlling said magnet to actuate said devices and means for maintaining the control of said magnet independently of its index-point control.

10. In apparatus of the character described, the combination with a record card having an index-point, devices adapted to be operated according to the location of the index-point, an electromagnet for controlling the operation of said devices, means actuated by the index-point for establishing the magnet-control of said devices and means for continuing such control independently of the means for establishing the same.

11. In apparatus of the character described, the combination of a record card having an index-point, an electric circuit, devices adapted to be operated according to the location of said index-point, an electromagnet in said circuit for controlling the operation of said devices, means for establishing the magnet-control of said devices initially by means of an index-point on the record card and means for maintaining such magnet-control independently of the record card after it has been established by the index-point.

12. In apparatus of the character described, the combination of a record card having an index-point, an electric circuit, an electromagnet in said circuit, devices controlled by said magnet and adapted to be operated according to the location of the index-point, means for opening and closing said circuit by means of an index-point to establish the magnet control of said device, a branch circuit, and means for controlling the branch circuit to maintain the magnet-control of said devices.

13. In apparatus of the character described, the combination of a record card having an index-point, an electric circuit controlled by means of the index-point, an electro-magnet in said circuit, devices adapted to be actuated according to the location of said index-point, contacts in said circuit actuated by means of the index-point for bringing said devices under the control of said magnet and a magnet-operated contact for maintaining the magnet-control of said devices.

14. In apparatus of the character described, the combination with a record card having an index-point, of an electric circuit, devices adapted to be operated according to the location of the index-point, a magnet in said circuit for controlling the operation of said devices, record-controlled contacts in circuit with the magnet which are closed by the index-point for establishing the magnet-control of said devices and a magnet-operated contact for maintaining the control established by the index-point.

15. In apparatus of the character described, the combination with a record card having an index-point, devices adapted to be operated according to the location of the index-point, an electric circuit, an electro-magnet in said circuit for controlling the operation of said devices, record-actuated contacts for closing said circuit to establish the magnet-control of said devices and means for continuing such control after the record-actuated contacts are opened.

16. In apparatus of the character described, the combination of a record card having an index-point, devices adapted to be operated according to the location of said index-point, an electric circuit, an electro-magnet in said circuit for controlling the operation of said devices, record-actuated contacts for closing the circuit through the magnet to establish the magnet-control of said devices, and means for maintaining the circuit through the magnet independently of the record-actuated contacts.

17. In apparatus of the character described, the combination of a record card, having an index-point, devices adapted to be operated according to the location of said index-point, an electric circuit, an electro-magnet in said circuit for controlling the operation of said devices, record-actuated contacts for closing the circuit through the magnet to establish the magnet-control of said devices, a branch circuit around the record-actuated contacts, means for closing said branch circuit when the circuit is closed through the magnet to maintain the magnet circuit after the record-actuated contacts are opened, and means for opening the branch circuit independently of the record-actuated contacts.

18. In apparatus of the character described, the combination with a record card having an index-point, devices adapted to

be operated according to the position of said index-point, an electric circuit, means therein for controlling the operation of said devices, record-actuated contacts for controlling said circuit, means actuated by said contacts for establishing the control of said devices, and short-circuiting the record-actuated contacts to maintain such control and means for breaking the short-circuit to release such control.

19. In apparatus of the character described, the combination with a record card having an index-point, an electric circuit, record-actuated contacts therefor, means for imparting a relative movement to the record card and contacts, devices adapted to be operated according to the location of the index-point, on the record card, means for controlling the operation of said devices, means for establishing such control at a variable point in the relative movement of the record and the record-actuated contacts, means for short-circuiting the record-actuated contacts to maintain such control, and means for releasing such control at a predetermined point in said movement.

20. In apparatus of the character described, the combination with a record card having an index-point, or record actuated contacts, means for imparting a relative movement to the record card and contacts to actuate the latter during such movement, an electro-magnet in circuit with said contacts, devices adapted to be actuated according to the location of said index-point, means controlled by said magnet for actuating said devices, contacts actuated by the record-actuated contacts to short-circuit the latter and means for breaking said short-circuit at a predetermined point in the relative movement of the record and record-actuated contacts.

21. In apparatus of the character described, the combination with a record card having an index-point, or record-actuated contacts controlled by said index-point, an electro-magnet in circuit with the record-actuated contacts, magnet operated contacts in circuit with said magnet for controlling a circuit around the record-actuated contacts, devices adapted to be operated according to the location of said index-point, means actuated by said magnet for controlling the operation of said devices and means operating independently of the record-actuated contacts for maintaining the control of the circuit through the magnet.

22. In apparatus of the character described, the combination with a record card having an index-point, of an electric circuit, record-actuated contacts for establishing the control of said circuit, and means controlled by the electric circuit for maintaining such control.

23. In apparatus of the character described, the combination with a record card having an index-point, of an electric circuit, contacts for controlling said circuit, means for actuating said contacts in accordance with the location of the index-point to establish the control of said circuit and means under the control of said circuit for maintaining the control of the same.

24. In apparatus of the character described, the combination with a record card having an index-point, of an electric circuit, record-actuated contacts for establishing the control of said circuit and means controlled by the electric circuit independently of the record for maintaining such control.

25. In apparatus of the character described, the combination with a record card having an index-point, of an electric circuit, record-actuated contacts for closing said circuit and means controlled by the electric circuit for holding said circuit closed.

26. In apparatus of the character described, the combination with a record card having an index-point, of an electric circuit, record-actuated contacts for closing said circuit, and means controlled by the electric circuit for holding the same closed independently of the record card.

27. In apparatus of the character described, the combination with a record card having an index-point, of an electric circuit, contacts for controlling said circuit, means for actuating said contacts in accordance with the location of the index-point to establish the control of said circuit and means under the control of said circuit for maintaining the control of same.

28. In apparatus of the character described, the combination with a record card having an index-point, of an electric circuit, contacts for controlling said circuit, means for actuating said contacts in accordance with the location of the index-point, to establish the control of said circuit and means under the control of said circuit for maintaining the control of the same independently of the record card.

29. In apparatus of the character described, the combination with a record card having an index-point, of an electric circuit, contacts for said circuit, means for actuating said contacts to close the circuit in accordance with the location of the index-point, and means under the control of said circuit for holding the same closed.

30. In apparatus of the character described, the combination with a record card having an index-point, of an electric circuit, contacts for said circuit, means for actuating said contacts to close the circuit in accordance with the location of the index-point and means under the control of said circuit for holding the same closed independently of the record card.

31. In apparatus of the character de-

scribed, the combination with a record card having an index-point, an electric circuit, circuit-controlling means actuated by the index-point, means for imparting a relative movement to the record card and said circuit-controlling means whereby the latter are actuated to control the circuit at a variable point in such movement, means under the control of the circuit for maintaining its control and means for releasing such control at a predetermined point in such movement.

32. In apparatus of the character described, the combination with a record card having an index-point, an electric circuit, an electro-magnet, devices controlled by said magnet, circuit-controlling means actuated by the index-point, means for imparting a relative movement to the record card and said circuit-controlling means, whereby the latter are actuated to establish the control of said magnet at a variable point in said movement, means actuated by the circuit for maintaining such control and means for releasing such control at a predetermined point in said movement.

33. In apparatus of the character described, the combination with a record card having an index-point, an electric circuit, devices adapted to be operated according to the location of the index-point on the record card, an electro-magnet in said circuit, means actuated by the index-point for controlling said magnet to actuate said devices, means for maintaining the control of said magnet independently of its index-point control, and means for releasing such control.

34. In apparatus of the character described, the combination with a record card having an index-point, devices adapted to be operated according to the location of the index-point, an electro-magnet for controlling the operation of said devices, means actuated by the index-point for establishing the magnet-control of said devices, means for continuing such control independently of the means for establishing the same, and means for releasing such control.

35. In apparatus of the character described, the combination with a record card having an index-point, an electric circuit, devices adapted to be operated according to the location of the index-point, an electro-magnet in said circuit for controlling the operation of said devices, means for establishing the magnet-control of said devices initially by means of an index-point on the record card, means for maintaining such magnet-control independently of the record card after it has been established by the index-point, and means for releasing such control.

36. In apparatus of the character described, the combination with a record card having an index-point, devices adapted to be operated according to the location of said index-point, an electric circuit, means controlled by said circuit for controlling the operation of said devices, means actuated by an index-point and means coöperating therewith, but actuated independently of the index-point, for maintaining the control of said circuit for a variable period, the duration of which is determined by the location of the index-point on the record card.

37. In apparatus of the character described, the combination with a record card having an index-point, devices adapted to be operated according to the location of said index-point, an electric circuit, an electro-magnet therein for controlling the operation of said devices, means actuated by an index-point and means coöperating therewith but actuated independently of the index-point for maintaining the magnet-control of said devices for a variable period, the duration of which is determined by the location of the index-point on the record card.

38. In apparatus of the character described, the combination with a record card having an index-point, of an electric circuit, record-actuated contacts for establishing the control of said circuit, means controlled by the electric circuit for maintaining such control, and means for releasing such control.

39. In apparatus of the character described, the combination with a record card having an index-point, of an electric circuit, contacts for controlling said circuit, means for actuating said contacts in accordance with the location of the index-point to establish the control of said circuit, means under the control of said circuit for maintaining the control of the same, and means for releasing such control.

40. In apparatus of the character described, the combination with a record card having an index-point, of an electric circuit, record-actuated contacts for establishing the control of said circuit, means controlled by the electric circuit independently of the record for maintaining such control, and means for releasing such control.

41. In apparatus of the character described, the combination with a record card having an index-point, of an electric circuit, record-actuated contacts for closing said circuit, means controlled by the electric circuit for holding said circuit closed, and means for opening said circuit.

42. In apparatus of the character described, the combination with a record card having an index-point, of an electric circuit, record-actuated contacts for closing said circuit, means controlled by the electric circuit for holding the same closed independently of the record card, and means for opening said circuit.

43. In apparatus of the character described, the combination with a record card having index-points, registering devices

adapted to be operated according to the location of the index-points, an operating circuit for controlling the operation of said devices and means for holding said circuit under control for a variable period during each cycle of operation of the apparatus which is determined by the location of an index-point on the record.

44. In apparatus of the character described, the combination with a record card having index-points, indicating devices adapted to be operated according to the location of the index-points, an operating circuit for controlling the operation of said devices, and means for holding said circuit under control for a variable period during each cycle of operation of the apparatus which is determined by the location of the index-point on the record.

45. In apparatus of the character described, the combination with a record card, having index-points, a constantly rotating shaft, register wheels, rotating devices for engaging the wheels to rotate with the shaft and means for maintaining such engagements for a variable period at each operation, the duration of which is determined by the location of the index-point.

46. In apparatus of the character described, the combination with a record card having index-points, register wheels, continuously rotating, wheel-engaging devices, means for effecting the engagement of said devices with the wheel, means for maintaining said engagement for a variable period and means for releasing said engagement.

47. In apparatus of the character described, the combination with a record card having index-points, register wheels, continuously rotating, wheel-engaging devices, means controlled by the record for effecting the engagement of said devices with the wheels according to the location of the index-points, means for maintaining said engagement and means for simultaneously releasing said engagement.

48. In apparatus of the character described, the combination with a record card having index-points, record-actuated devices, means for imparting a relative movement to the record card and the record-actuated devices, rotatable register wheels corresponding to the record-actuated devices, means for starting the rotation of each wheel and means for stopping the rotation of each wheel, one of said means operating on the wheel when the record-actuated device for the wheel is actuated by an index-point, and the other of said means being operated at a fixed point in the relative movement of the record.

49. In apparatus of the character described, the combination with a record having index-point positions and index-points, record-actuated devices, means for moving the record to present the index-point positions successively to the record-actuated devices, rotatable register wheels, corresponding to the record-actuated devices, means for starting the rotation of each wheel and means for stopping the rotation of each wheel, one of said means operating on the wheel when the record-actuated device for the wheel is actuated by an index-point, and the other of said means being operated independently of the record-actuated devices.

50. In apparatus of the character described, the combination with a record having index-point positions and index-points, record-actuated devices, means for moving the record to present the index-point positions successively to the record-actuated devices, rotatable register wheels corresponding to the record-actuated devices, means for starting the rotation of each wheel when its record-actuated device is actuated by an index-point, and means, operated at a fixed point in the movement of the record, for stopping the rotation of each wheel.

51. In apparatus of the character described, the combination with a record having index-points, record-actuated devices, a motor, mechanism actuated thereby to move the records relatively to the record-actuated devices, rotatable register wheels corresponding to the record-actuated devices, means for starting the rotation of each wheel and means for stopping the same, one of said means being operated when the record-actuated device for the wheel is actuated by an index-point and the other of said means being operated by the motor at a fixed point in the movement of the record.

52. In apparatus of the character described, the combination with a record having index-point positions and index-points, record-actuated devices, a motor, mechanism actuated thereby to move the record to present the index-point positions successively to the record-actuated devices, rotatable register wheels, corresponding to the record-actuated devices, means for starting the rotation of each wheel when its record-actuated device is actuated by an index-point and means operated by the motor for stopping the rotation of each wheel at a fixed point in the movement of the record.

53. In apparatus of the character described, the combination with a record card, having index-point positions and index-points, record-actuated devices, means for imparting a relative movement to the record and said devices, a rotating shaft, register wheels, clutches for connecting said wheels with said shaft, means for engaging each clutch, and means for disengaging the same, one of said means being operated at a fixed point in the relative movement of the record and the record-actuated devices and the other of said means being operated at a variable point in said movement, which

point is determined by the location of the index-point.

54. In apparatus of the character described, the combination with a record card, having index-point positions arranged in columns and index-points, record-actuated devices, means for moving the record to present the index-point positions of each column successively to its record-actuated device, a rotating shaft, register wheels, clutches for connecting said wheels with said shaft, means for engaging each clutch and means for disengaging the same, one of said means being operated at a variable point in the movement of the record, determined by the location of the index-point, and the other of said means being operated at a fixed point in the movement of the record.

55. In apparatus of the character described, the combination with a record card having index-point positions arranged in columns and index-points, record-actuated devices, means for moving the record to present the index-point positions of each column successively to its record-actuated device, a rotating shaft, register wheels, clutches for connecting said wheels with said shaft, means for engaging said clutch and means for disengaging the same, one of said means being operated when a record-actuated device is actuated by an index-point and the other of said means being operated at a fixed point in the movement of the record card.

56. In apparatus of the character described, the combination with a record card having index-point positions and index-points, record-actuated devices, means for moving the record to present the index-point positions successively to the record-actuated devices, a rotating shaft, register wheels, clutches for connecting said wheels with said shaft, means for engaging each clutch at a variable point in the movement of the record determined by the location of the index-point and means for disengaging each clutch at a fixed point in the movement of the record card.

57. In apparatus of the character described, the combination with a record card having index-point positions and index-points, record-actuated devices, means for moving the record to present the index-point positions successively to the record-actuated devices, a rotating shaft, register wheels, clutches for connecting said wheels with said shaft, means for engaging each clutch when the record actuates its record-actuated device, and means actuated independently of the record for disengaging said clutch.

58. In apparatus of the character described, the combination with a record card having index-point positions and index-points, record-actuated devices, a motor, means actuated by the motor for moving the record to present the index-point positions successively to the record-actuated devices, a rotating shaft driven by the motor, a register wheel for each record-actuated device, a clutch for connecting each wheel with said shaft, means for engaging each clutch and means for disengaging each clutch, one of said means being operated by the motor and the other of said means being operated when the record-actuated device is actuated by the index-point.

59. In apparatus of the character described, the combination with a record card having index-point positions and index-points, record-actuated devices, a register wheel for each record-actuated device, a motor, means operated by the motor for moving the record to present the index-point positions successively to the record-actuated devices, a rotating shaft driven by the motor, a clutch for connecting each wheel with said shaft, means operated when its record-actuated device is actuated by an index-point for engaging said clutch, and means operated by the motor for disengaging said clutch when the card reaches a fixed point in its movement.

60. In apparatus of the character described, the combination with a record card having index-points, an electric circuit, contacts in said circuit adapted to be actuated by the index-points at a variable point in the movement of the record card according to the location of the index-points, means for moving the record card relatively to said contacts, and a contact in said circuit adapted to be closed and opened by the record card at fixed points in its movement.

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TABULATING MACHINE.

APPLICATION FILED APR. 1, 1912.

1,087,061.

Patented Feb. 10, 1914.

3 SHEETS—SHEET 1.

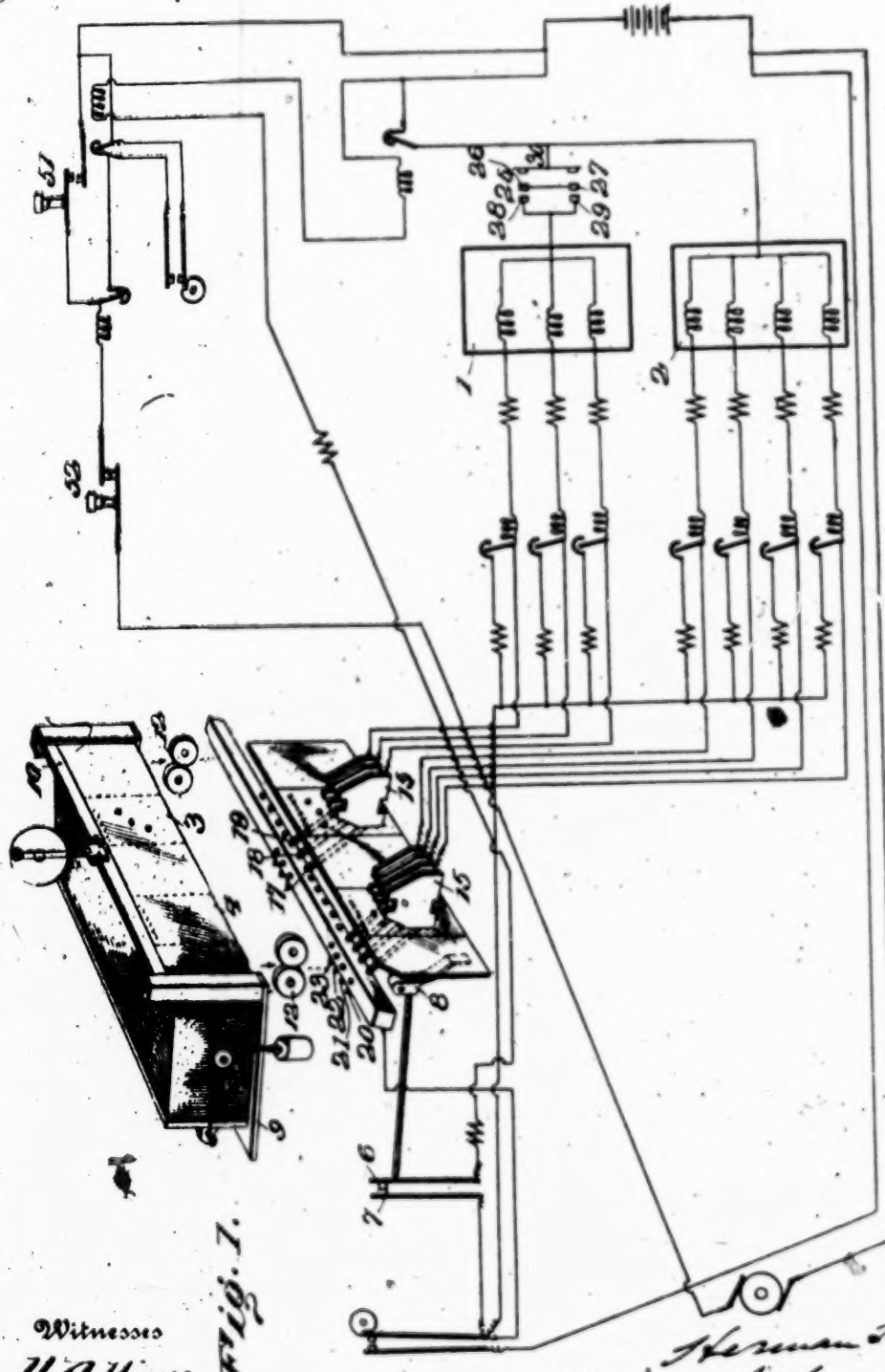

Fig. 1.

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3 SHEETS—SHEET 2

Fig. 2.

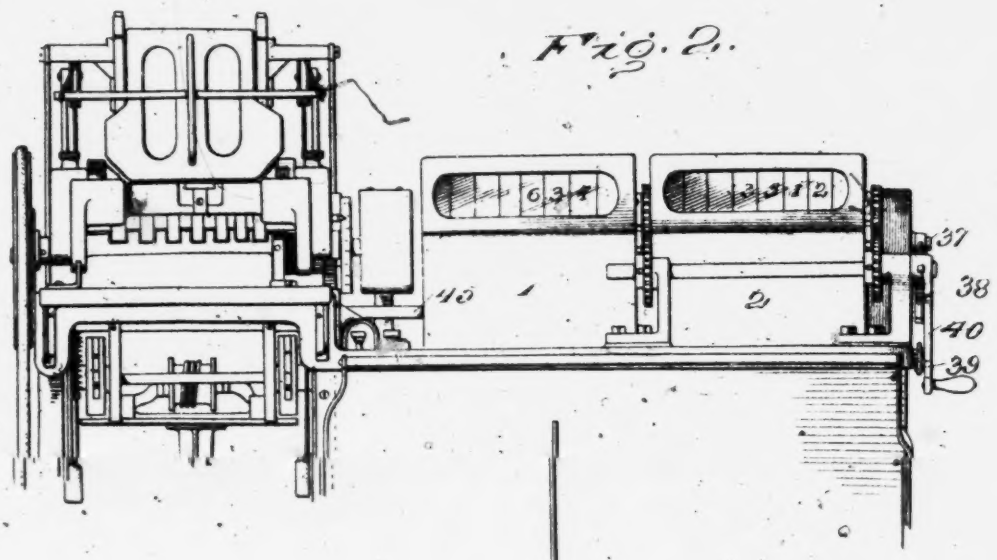

Fig. 7.

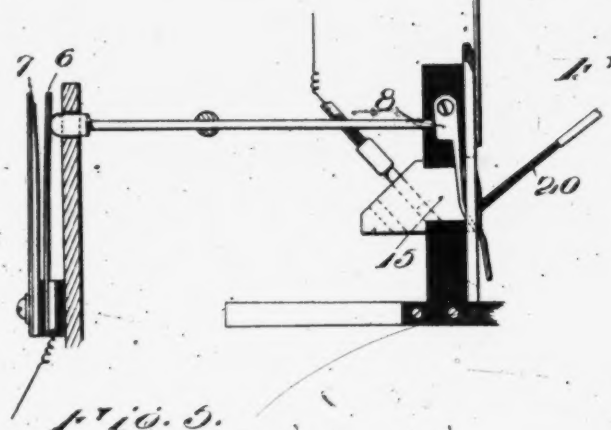

Fig. 5.

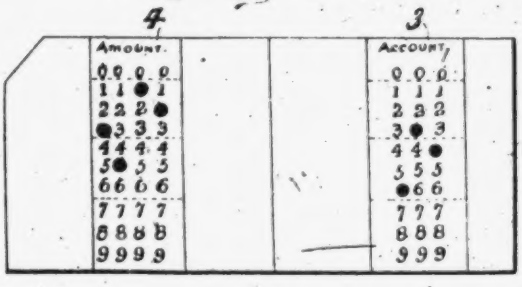

Fig 6.

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3 SHEETS—SHEET 3.

Fig. 3.

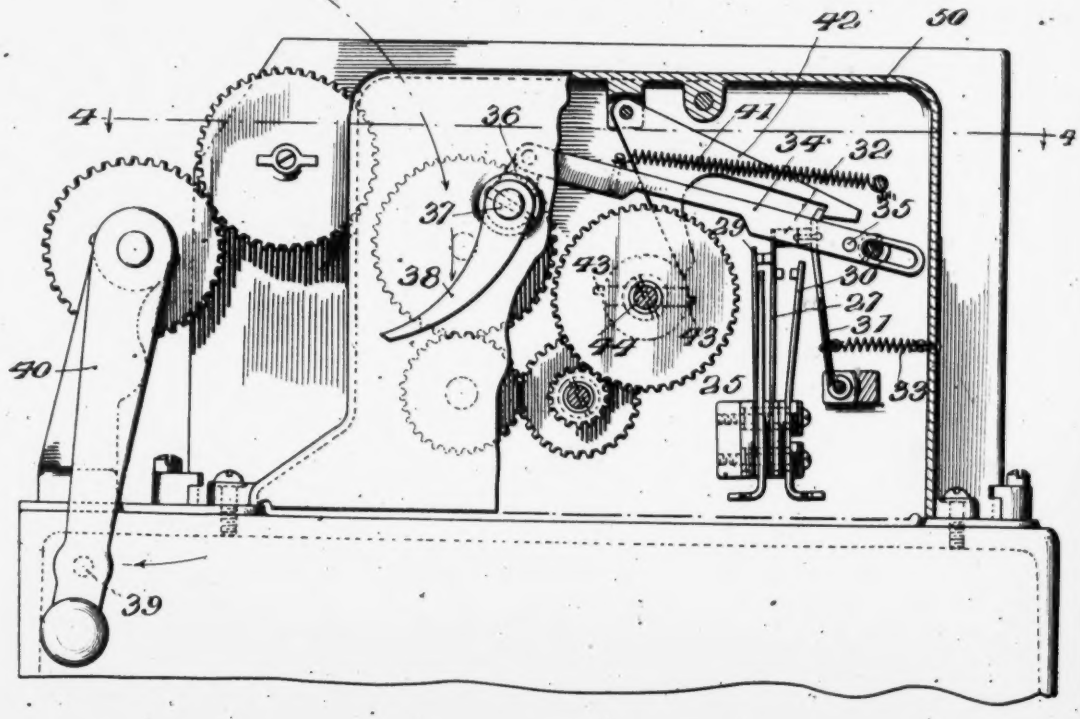
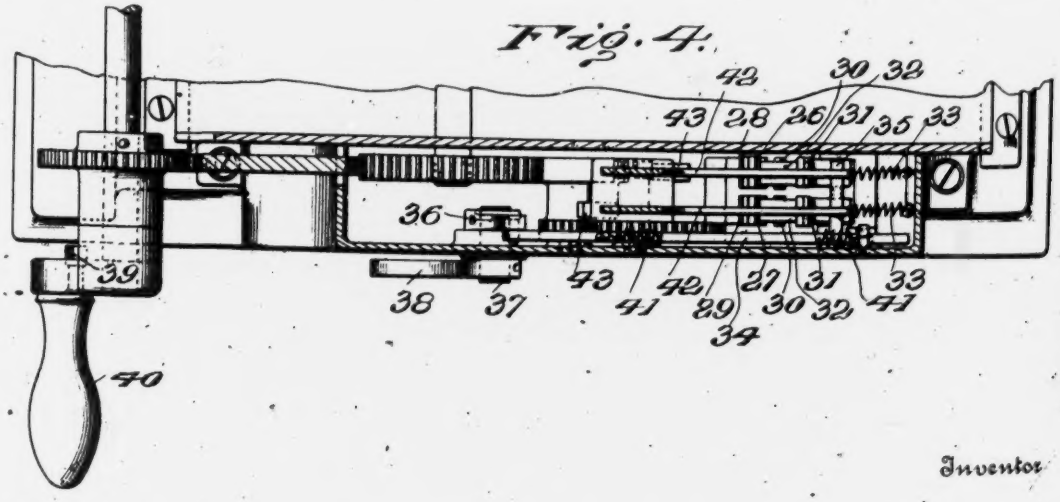


Fig. 4.



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UNITED STATES PATENT OFFICE.

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TABULATING-MACHINE.

1,087,061. Specification of Letters Patent. Patented Feb. 10, 1914.

Application filed April 1, 1912. Serial No. 687,844.

To all whom it may concern:

Be it known that I, HERMAN HOLLERITH, of Washington, in the District of Columbia, have invented certain new and useful Improvements in Tabulating-Machines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The Hollerith tabulating system, as is well known, employs a record-card having index-points, preferably punched holes, which are located on each particular record-card in accordance with the data which that card represents. The system comprises, among other things, apparatus for registering the items constituting the record formed on each record-card and totalizing or integrating the items of any one or more columns of the record-cards, and also apparatus for sorting or classifying the record-cards into different series.

Frequently it is desirable to totalize or integrate a particular record represented by a series of record-cards. For instance, after the record-cards have been sorted or classified according to a particular class, it is desired to totalize the record represented by the index-point positions in a corresponding group of all the classified record-cards. To be more specific, let it be assumed that all the record-cards belonging to a specific account have been sorted or classified according to say the "account" number as represented by the index-point positions in the "account" group, and that it is desired to totalize the record indicated by the index-point positions in the "amount" group of a series of record-cards belonging to the selected account. The apparatus will include at least two record-actuated registers, one being controlled by the index-point positions of the "account" group (which is the same on all the cards) and the other by the index-point positions of the "amount" group, the record of which will be totalized or integrated as all the cards of that particular account are passed through the apparatus.

In some instances it is desired to place at one time in the apparatus several different series of sorted or classified record-cards, and to separately integrate the record as represented by the index-point positions of a particular group of all the record-cards of each series. In other words, in the illustration given, it may be desired to separately totalize the records of the "amount" group of each of a series of different accounts, in which event the register controlled by the record of the "account" group should be actuated only as a new account group is brought into control.

The object of my present invention is to automatically prevent one of a series of registers from being actuated by a second series of record-cards until all the registers have been returned to zero.

Electricity is the agent preferably employed for effecting the control or operation of the apparatus but it is not my intention to restrict my invention to the employment of that particular operating or controlling agent since other equivalent means may be employed instead of an electric circuit or circuits and electrically operated devices hereinafter described; but I consider electricity to be the most advantageous agent and have therefore selected, for the purpose of description, an electrically operated apparatus, and in this connection it is to be understood that where electricity is employed as an actuating or controlling agent the apparatus may be arranged for operation either on open or closed circuits.

In the accompanying drawings, Figure 1 is a diagrammatic view with parts in perspective. Fig. 2 is an elevation of a portion of a tabulating machine equipped with my improvement. Fig. 3 is an end elevation, with parts broken away, showing the circuit controller and coöperating parts. Fig. 4 is a section on line 4—4, Fig. 3. Fig. 5 is a face view of a record card. Fig. 6 is a similar view of a stop card. Fig. 7 is an enlarged detail view showing contact points and record-controlled closer.

In the form of record-card which I have selected for the purpose of illustrating and describing my invention, but without intending to limit my invention thereto, the index-point positions, as shown in Fig. 5, are denoted by printed figures arranged in groups, each group consisting of one or more columns of figures comprising the nine digits and the cipher substantially as shown in my U. S. Letters Patent No. 777,209, with the cipher at the top of each column in horizontal alinement and the digits following in order down each column to the figure 9. To secure brevity in this description I have

shown only two groups, one consisting of three columns of index-point positions, and the other of four columns of index-point positions, but in actual practice the record-card may contain several different groups, but this theoretical form of record will enable the principle of operation of my present invention to be readily understood. Following out this plan of illustrating my invention I have conventionally shown in Fig. 2, two registers 1 and 2, the former being controlled by the index-point positions in group 3 of the record-cards, and the latter by the index-point positions in group 4 of the record-cards. Of course there may be any desired number of registers, each being controlled by the index-point positions in its respective group of the record-cards. The invention will be readily understood if the index-point positions in group 3 are considered as representing "account" numbers, and the index-point positions in group 4 as representing the "amount" chargeable to such account. Assuming that the record-cards of a given "account" number have been sorted, and it is desired to totalize the record represented by the index-point positions in the "amount" groups of the several cards, the register 1 will be operated when the first card of a series is in control, and so also will the register 2 be operated if that card contains index-point positions in the respective group.

According to my present invention, the register 1 is normally disconnected, but at some point during the first revolution of the apparatus a circuit through this register is closed, and during the second revolution of the apparatus, or exactly one cycle later than the point in the first revolution at which it was closed, this circuit is again opened. Or in other words, the circuit is held closed during the time the index-point positions of a single card are passing through the circuit-controlling position. In consequence, the register 1 is under electrical control for only sufficient time to allow it to be actuated by the respective index-point positions of the first card, and is immediately rendered inoperative before the respective index-point positions of the next succeeding card come into position to control.

The different series of record-cards, stacked together ready to be fed to the apparatus, are separated by stop-cards. Such a stop-card is shown in Fig. 6, and the only index-point positions thereon correspond to those of the selected series, namely, in the illustration employed, the respective "account" number. These stop-cards differ from the record-cards also in that while the latter, as pointed out in my U. S. Letters Patent No. 945,236, maintain the circuit, or allow it to be maintained, the stop-cards when brought into control-position allow the machine to automatically stop. The record-cards when in control-position actuate a contact to maintain the circuit. The stop-cards when in control-position cannot actuate the contact, for that each is cut away, as at 5, and in consequence the apparatus will cease to operate. In Fig. 7 I have shown the contact as consisting of two opposed spring-contact arms 6 and 7 which are controlled by a lever 8 with which the record-cards engage to complete the circuit.

The records are preferably placed on edge, with the cipher at the top, upon a platform 9 and are fed one by one to the action of record-actuated contacts, by a reciprocating cross-head 10, and by feed rollers 12. As the feeding-mechanism shown is substantially similar to that described in my U. S. Letters Patent No. 945,236, further description is unnecessary. The conducting brushes are normally in contact with plates 15, insulated from each other, but the brushes and their contact plates are separated when a card is fed down between them. The plates 15 are electrically connected each with one of the indicators of the registers. The conducting brushes 17, 18 and 19 are controlled by the index-point positions of the "account" group, and the brushes 20, 21, 22 and 23 by the index-point positions of the "amount" group. Each brush and its respective plate 15 form a pair of electrical contacts, which are actuated or permitted to come together and move apart, by the record. When a card is fed down between the brushes and the contact-plates 15 the index-point positions of each column, each of which represents a different characteristic or amount, are presented successively to the brushes or record-actuated devices, and when the punched hole in a column registers with the brush of that column, the brush will contact with its complementary member, and an electrical contact will be momentarily established and the corresponding indicator of the respective register will be operated in the manner well-known according to the Hollerith system.

The register 1 is, as before stated, normally disconnected, but during the first revolution of the apparatus the circuit through this register is closed and is again opened during the second revolution. For accomplishing this purpose various means may be employed. According to that shown, a circuit controller 25 is located within the circuit of this register, and it comprises two electrically-connected spring-contact arms 26 and 27, which normally are in engagement with two contacts 28 and 29. During the first revolution of the apparatus, one of these arms 26, 27, will be released and close the circuit through one of two contacts

30, and during the next revolution the other contact arm will be released and engage the other of the contacts 30, thus completely opening the circuit of the register controlled by the index-point positions of the "account" group. The circuit-controller 25 of register 1, cannot be restored to its normal position until the indicators of both registers are returned to zero. The two contact arms 26 and 27 are moved into engagement with contacts 28 and 29 by two spring-held arms 31 carrying blocks 32 of insulation, which arms are moved in opposition to their springs 33 by a link 34 carrying a laterally-projecting stud 35 and connected to an arm 36 of a shaft 37 on the outer end of which is a cam arm 38, which latter is designed to be engaged by a stud 39 carried by the resetting lever 40 of the registers. A spring 41 holds the resetting parts of the controller in their normal positions. When the contact arms 26 and 27 are reset they are engaged and held by the hooked ends of two pivoted trips 42 from which extend arms which lie in the path of two diametrically-disposed studs 43 carried by a shaft 44, which by suitable reducing gearing, actuated preferably by the main operating shaft 45, is revolved at half speed, that is to say, the shaft 44 is given a half revolution in each cycle of operation. In this half revolution, one of the trips 42 is actuated to release its respective contact arm, 26 or 27, and close the circuit through register 1, and during the passage of the next card the other trip is actuated to release the other contact arm and completely open the circuit, thereby cutting out the register 1 after it has been actuated by the respective index-point positions, of the first card, be it a record-card or a stop-card. The closing of the circuit through the register 1 always occurs before any of the index-point positions of a card come into position to effect actuation through the record-controlled devices.

Any desired form of registering apparatus embodying directly actuated indicating members with means for carrying or transferring from one member to that of the next higher order, accumulating members and zero resetting devices may be employed, and I have therefore not considered it necessary to illustrate or describe the same in detail since their construction and operation are well understood in the art. The circuit controller is preferably located at one side of the registers, and is shown as being inclosed by a casing 50. The electric circuit will be readily understood from Fig. 1. It comprises a motor, suitable magnets and relays and also starting and stopping contacts 51 and 52.

While for the purpose of illustrating and clearly describing my invention, I have selected certain specific means and forms of apparatus in which it is embodied, it is to be understood that the same may be modified in many respects without departing from the principle or spirit of the invention as set forth in the claims.

I claim as my invention:

1. In an apparatus of the character described, the combination with a record card having index-point positions, of two record-actuated registers, and means for automatically throwing one register out of operation after the first cycle of operation.

2. In an apparatus of the character described, the combination with a record card having index-point positions, of two record-actuated registers, one of which is normally inoperative, means for throwing such latter register into operation at the beginning of a cycle of operation of the apparatus, and means for throwing such register out of operation at the end of that cy

3. In apparatus of the character described, the combination with a record card having index-point positions, of two record-actuated registers, an operating circuit, one of said registers being normally disconnected from said circuit, and means for automatically throwing such latter register into circuit during a cycle of operation, and then disconnecting such register from such circuit.

4. In apparatus of the character described, the combination with a record-card having index-point positions, of two record-actuated registers, an operating circuit, one of said registers being normally disconnected from said circuit, and means for automatically throwing such latter register into and out of circuit while the other register remains in circuit.

5. In apparatus of the character described, the combination with a record-card having index-point positions, of two record-actuated registers, an operating circuit, one of said registers being normally disconnected from said circuit, and means for automatically throwing such latter register into circuit when the record-card comes into operative position, and then disconnecting such register from such circuit after the record-card leaves its operative position.

6. In apparatus of the character described, the combination with record-cards having index-point positions, of two record-actuated registers, an operating circuit, one of said registers being normally disconnected from said circuit, and means for automatically throwing such latter register into circuit when a record-card comes into operative position, and then disconnecting such register from such circuit after such record-card leaves its operative position while the other register remains in circuit, subject to control by succeeding record-cards.

7. In apparatus of the character described, the combination with a record-card having index-point positions, of two record-actuated registers, an operating circuit, and means for automatically throwing one of said registers out of circuit at a predetermined point in a cycle of operation.

8. In apparatus of the character described, the combination with a series of record-cards having each index-point positions, of two record-actuated registers, and means for rendering one of the registers inoperative at a predetermined point in the cycle of operation.

9. In apparatus of the character described, the combination with a series of record cards having each index-point positions, of two record-actuated registers, and means for rendering one of the registers inoperative after the first record card leaves its operative position.

10. In apparatus of the character described, the combination with a series of record-cards having each index-point positions arranged in groups, of two record-actuated registers, each controlled by the index-point positions of one group, and means for rendering one of the record-actuated registers first operative when a record-card comes into operative position and then inoperative after such record-card leaves its operative position.

11. In apparatus of the character described, the combination with a series of record-cards having each index-point positions arranged in groups, of two record-actuated registers, each controlled by the index-point positions of one group, an operating circuit, and means for automatically cutting out the register actuated by the index-points in one of the groups without interfering with the other register.

12. In apparatus of the character described, the combination with record-cards arranged in series and having each index-point positions, of two record-actuated registers, means for automatically rendering one register inoperative after the first record-card of each series leaves its operative position, and means operable as each series of record-cards is exhausted for stopping the apparatus.

13. In apparatus of the character described, the combination with record-cards arranged in series and having each index-point positions, of two record-actuated registers, one of which is normally disconnected, means for connecting such latter register when the first record-card comes into operative position, means for again disconnecting such register after the first record-card leaves its operative position, and means operable as each series of record-cards is exhausted for stopping the apparatus.

14. In apparatus of the character described, the combination with record-cards having index-point positions, of two record-actuated registers, an operating circuit, a circuit-controller for one of said registers, and means for automatically actuating said circuit-controller, when the first record-card comes into operative position, to throw its respective register into operation and then out of operation after such record-card leaves its operative position.

15. In apparatus of the character described, the combination with record-cards having index-point positions, of two record-actuated registers, an operating circuit, a circuit-controller for one of said registers, means for automatically actuating said circuit-controller, when the first record-card comes into operative position, to throw its respective register into operation and then out of operation after such record-card leaves its operative position, and means for restoring the circuit-controller to its normal position in resetting the registers.

16. In apparatus of the character described, the combination with a record-card having index-point positions, of two record-actuated registers, an operating circuit, a circuit-controller for one of said registers, comprising two contacts, and means for successively actuating said contacts to throw such register into operation during the first cycle of operation and out of operation on the next cycle of operation.

17. In apparatus of the character described, the combination with a record-card having index-point positions, of two record-actuated registers, an operating circuit, a circuit-controller for one of said registers, comprising two contacts, means for successively tripping said contacts to throw such register into and out of operation, and means for resetting said circuit-controller.

18. In apparatus of the character described, the combination with a record-card having index point positions, of two record-actuated registers, an operating circuit, a circuit controller for one of said registers, comprising two contacts, means for successively tripping said contacts to throw such register into and out of operation, and means for resetting said circuit-controller by the resetting of the registers.

In testimony whereof, I have signed this specification in the presence of two subscribing witnesses.

HERMAN HOLLERITH.

Witnesses:
J. NOTA MCGILL,
FRANCIS S. MAGUIRE.

Department of Commerce, United States Patent Office
Claims Div.

To all persons to whom these presents shall come, Greeting:

This is to certify that the annexed is a true copy from the records of this office of the Specification and Drawing, in the matter of the German Letters Patent to Accounting and Tabulating Corporation, Dated June 7, 1918, Number 367,646, Verfahren und Einrichtung zur Auswertung statistischer Angaben mittels gelochter Zahlkarten.

This certified copy ordered by the Department of Justice.

In testimony whereof I have hereunto set my hand and caused the seal of the Patent Office to be affixed, at the City of Washington, this twelfth day of November, in the year of our Lord one thousand nine hundred and thirty-five and of the Independence of the United States of America the one hundred and sixtieth.

Conway P. Coe, Commission of Patents. (Seal Patent Office; United States of America.)

Attest: D. E. Wilson, Chief of Division.

DEUTSCHES REICH

AUSGEGEBEN
AM 24. JANUAR 1923

REICHSPATENTAMT

PATENTSCHRIFT

№ 367646

KLASSE 43a GRUPPE 41

(G 46730 IX/43a)

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U. S. PATENT OFFICE

Accounting and Tabulating Corporation in New York, V. St. A.

Verfahren und Einrichtung zur Auswertung statistischer Angaben mittels gelochter Zählkarten.

Patentiert im Deutschen Reiche vom 7. Juni 1918 ab.

Die für statistische Maschinen verwendeten Lochkarten besitzen horizontale aufgedruckte Zahlenreihen 0 bis 9 derart, daß vertikale Zahlenreihen mit der Ziffernfolge 0 bis 9 entstehen. Selbst wenn die benachbarten Ziffern bzw. Löcher so dicht nebeneinanderstehen, daß nur ein ganz schmaler Streifen Papier stehen bleibt, ist die zur Darstellung eines Zahlenwertes in Lochschrift erforderliche Papierbreite, verglichen mit der Höhe des gleichen Zahlenwertes in Druckschrift, ungefähr 10mal größer. Dieser große Papieraufwand erfährt eine weitere Steigerung dadurch, daß der Abstand von Horizontalreihe zu Horizontalreihe mit Rücksicht auf konstruktive Erfordernisse und auf sicheres Arbeiten der Loch-, Sortier- und Addiermaschine breiter sein muß als das entsprechende Maß in horizontaler Richtung. So zeigen die in der Praxis verwendeten Lochkarten eine vertikale Entfernung von Lochmitte zu Lochmitte gleich dem Doppelten des Lochdurchmessers. Die Kartenbreite beträgt also ohne Berücksichtigung des die Überschrift tragenden Kartenkopfes das Zwanzigfache eines Lochdurchmessers.

Gegenstand der Erfindung ist ein Verfahren, durch welches ohne wesentliche Änderung der Konstruktion der bekannten statistischen Maschinen eine Verbesserung der Papierausnutzung auf das Doppelte erreicht wird, und zwar dadurch, daß ein und dieselbe Karte nacheinander für zwei verschiedene Geschäftsvorgänge benutzt wird. Dies ist in der Weise möglich, daß die Karte mit verschiedenen, nacheinander zur Auswertung zu benutzenden Systemen von Löchern versehen ist, deren eines diejenigen Zwischenräume einnimmt, die mit Rücksicht auf den nötigen Abstand der Lochstifte (bei mechanisch arbeitenden Maschinen) oder den notwendigen Zeitabstand zwischen der Abtastung zweier hintereinanderliegender Löcher (bei elektrisch arbeitenden Maschinen) von Löchern freibleiben müssen. Die Maschinen besitzen Vorrichtungen mittels deren sie wahlweise durch das erste oder zweite System der Löcher gesteuert werden können.

Die Erfindung läßt sich in verschiedener Weise ausführen. Einige Lösungen der gestellten Aufgaben sind nachstehend beschrieben und durch Zeichnungen erläutert.

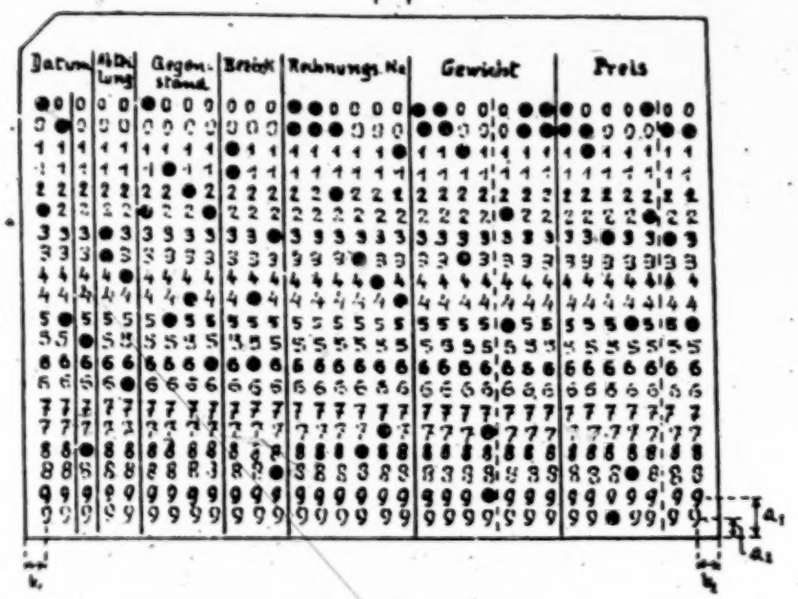
Abb. 1. Die hier dargestellte Lochkarte zeigt an Stelle der bei den bekannten Lochkarten vorhandenen zehn horizontalen Zahlenreihen zwanzig solcher Reihen, und zwar derart, daß die mit ausgezogenen Linien dargestellten Ziffern dem einen System die gestrichelt dargestellten Ziffern dem zweiten System angehören. Die Ziffern bzw. Löcher des einen Systems liegen in den Zwischenräumen der Ziffern der Vertikal-

370-375

340A

Zu der Patentschrift 367646
Kl. 43a Gr. 41

Abb. 1.



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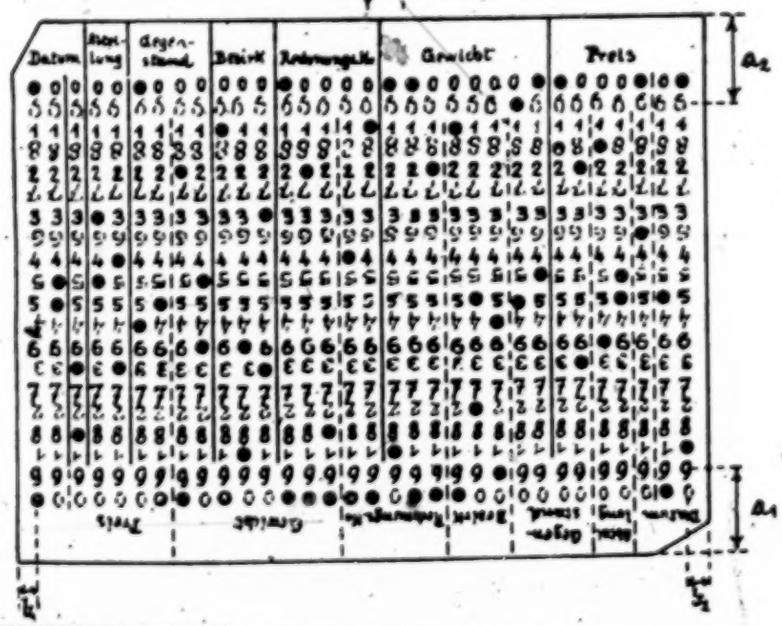

Zu der Patentschrift 367646
Kl. 43a Gr. 41
Blatt I.

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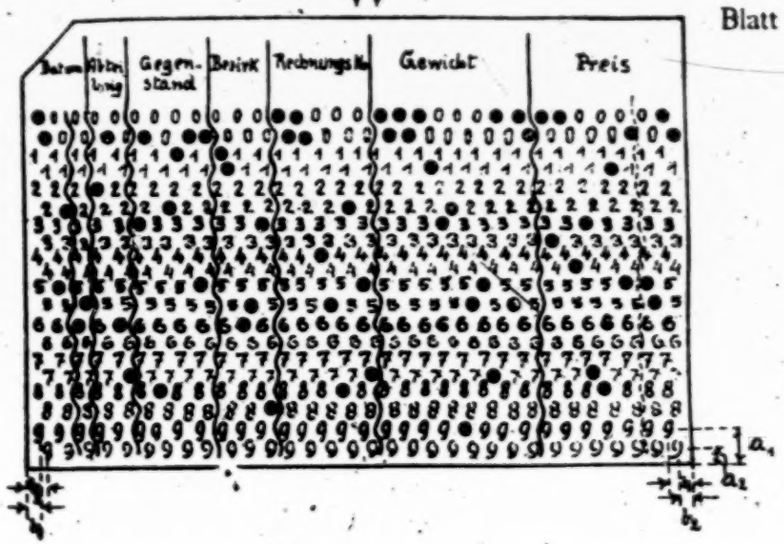

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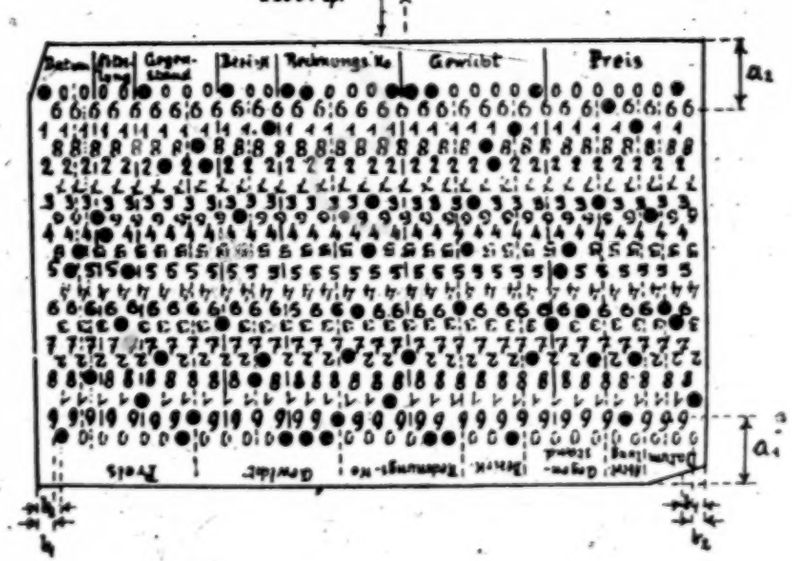

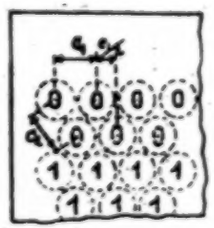

Abb. 3a

Zu der Patentschrift 367646
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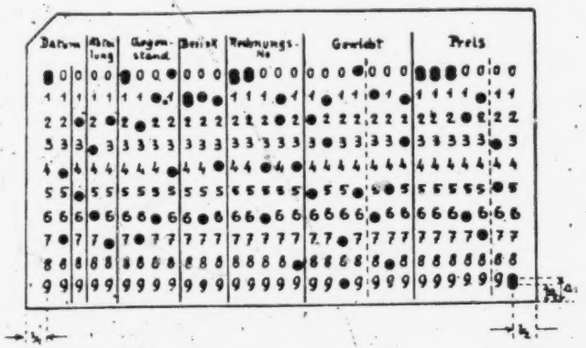

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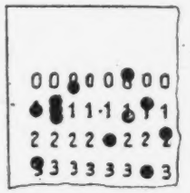

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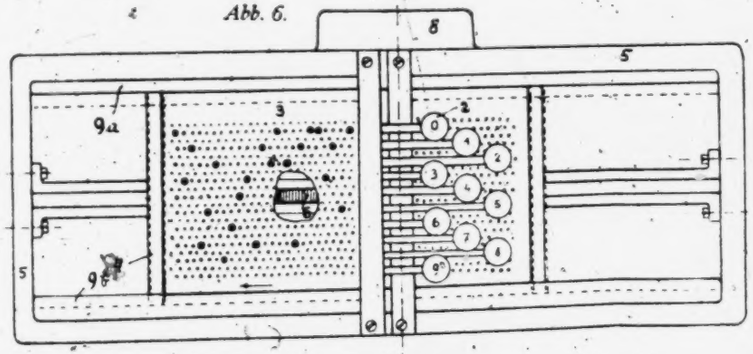

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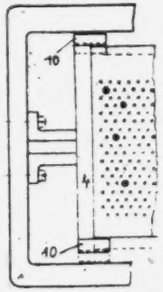

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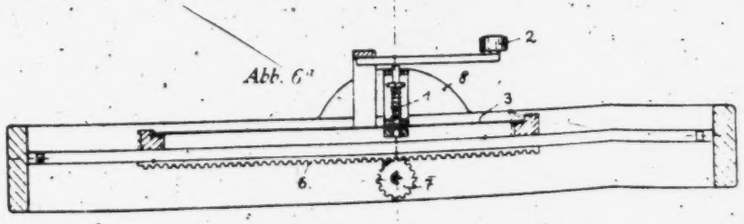

Zu der Patentschrift 367646
Kl. 43a Gr. 41

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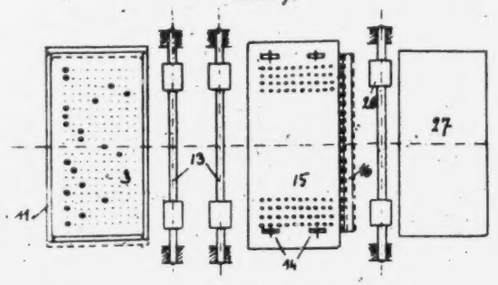

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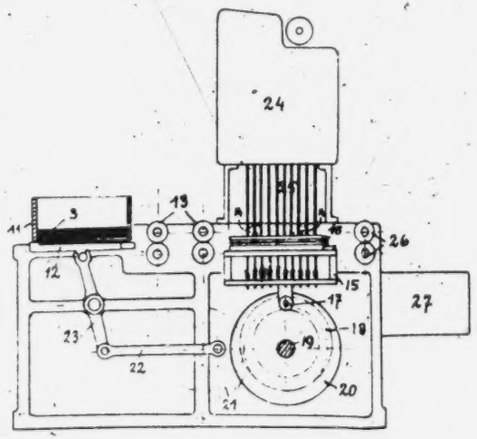
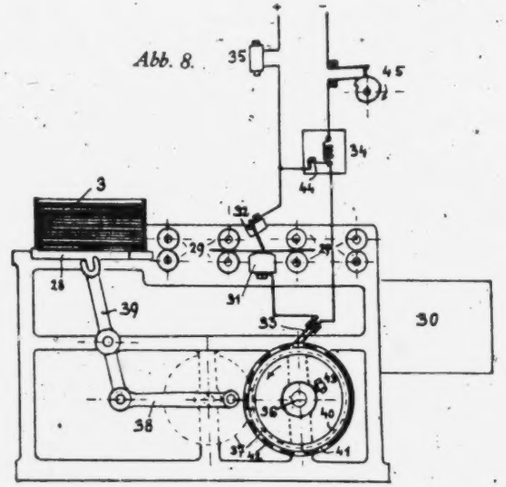


Zu der Patentschrift 367646
Kl. 43a Gr. 41
Blatt II.

Abb. 8.



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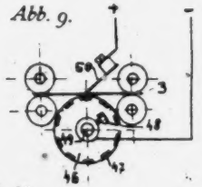

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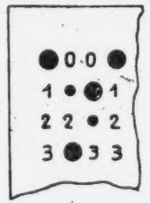

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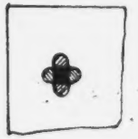

PHOTOGR. DRUCK DER REICHSDRUCKEREI

[fol. 378] Translation

German Patent 367,646

Accounting and Tabulating Corporation in New York, U. S. A.

The punched cards used for statistical machines have horizontal rows of numbers running from 0 to 9 in such a manner that vertical rows of numbers in the sequence of 0 to 9 are the result. Even if the neighboring numbers resp. perforations are so close together that only a very narrow strip of papers remains, the width of paper necessary to represent a number in perforations is a comparison to the height of the same number, in printing about ten times as large. This large usage of paper is increased further by virtue of the fact that the distance of the one horizontal row to the next horizontal row must, in consideration of the constructive requirements and secure operation of the punching-, sorting- and adding machine, be wider than the corresponding rate in horizontal direction. Thus the cards in practical usage show a vertical distance from center of hole to center of hole equal to double the diameter of the perforation. The width of the card, therefore, is without consideration, of the head of the card on which the head is printed the twenty-fold of one perforation diameter.

The subject of the invention is a procedure by which an improvement in the efficiency of paper use can be obtained, to the effect of trice the efficiency without essential change in the construction of known statistical machines, and this by the fact, that one and the same card is used for two different business operations one after another. This is possible in this manner, that the card is provided with different systems of perforations which can be used one after another for control of the machines, and one of which systems is placed in those intermediary spaces, which must remain free of perforations in consideration of the necessary distance of the perforation pins (in mechanically operated machines), or in consideration of the necessary timed interval between sensing of the two successive perforations (in electrically operated machines). The machines have devices by means of which they can be controlled selectively by the first or second system of perforations.

The invention can be constructed in various forms. Several solutions of the problems are described below and explained by drawings.

Fig. 1. The punched card shown here shows, instead of the ten horizontal rows of numbers present in the known punched cards, twenty of such rows, and in such a manner that the numbers in full lines belong to one system, and [fol. 379] the numbers in dotted lines to the second system. The numbers resp. perforations in one system are placed in the spaces between the numbers of the vertical rows of the other system. Their succession from 0 to 9 in both systems, goes from above to beneath. The vertical lines which divide the card in fields as well as the printings on top are common to both systems. The distances of the number rows 9 from the nearest card edge is referred to by a_1 resp. a_2. The distances of the outside vertical number columns from the card edge b_1 resp b_2 are equally large for both sides.

Fig. 2. This card also has printed on it double rows of numbers, which for one system are shown in full lines, and for the other system in dotted lines. The numbers resp. perforations of one system are placed in the spacings between the numbers of the vertical rows of the other system. Their succession from 0 to 9 in one system goes from above to beneath, and the other system also from above to beneath after a turn of 180°. For each system separate vertical separation lines and printed headings are necessary over the resulting fields. The distances of the number rows 9 from the nearest card edge are referred to with a_1 resp. a_2. The distances of the far outside vertical columns from the card edge are equally as large for both sides and referred to by b_1 resp b_2. In order to prevent that as a result of the wrong position in the card stack, perforations of the other perforation system can control the machine, the card has been given at two diagonally placed corners different cutoffs which permits to recognize cards which are placed wrong.

Fig. 3. The card of this kind shows a similar arrangement of number rows as shown by Fig. 1, only in this case the numbers resp. perforations of one system are placed vertically above resp. beneath the spacings between neighboring perforations of the other system. This arrangement

permits a more favorable use of the paper than is the case according to Fig. 1. The best arrangement results, with the distances c_1 and c_2 (Fig. 3[a]) equally as large. The distances of the number rows 9 from the nearest card edge have been referred to by a_1 resp. a_2. The distances of the far outside vertical columns from the card edge have been referred to by b_1 resp. b_2.

Fig. 4. The card shown here is a combination of the cards of Fig. 2 and 3. The perforations with the same meaning of one system are placed vertically beneath resp. above the spaces between neighboring perforations of the other system. The succession of the numbers resp. perforations from 0 to 9 in one system goes from above to beneath and also from above to beneath in the other system when the card has been rotated 180°. The distances a_1, a_2, b_1, b_2 have the same meaning as in Figs. 2 and 3.

[fol. 380] Fig. 5 shows a card similar to the card of Fig. 1, however the perforations are not placed alongside each other but eccentrically in relation to each other, and printing of the numbers need only take place in single columns. The distances a_1, a_2, b_1, b_2 have the same meaning as in Fig. 1. The arrangement described above with perforations eccentrically arranged in relation to each other, can also be used for the cards shown in Figs. 2, 3 and 4.

Fig. 5[a]. If in the solution shown in Fig. 5 a third perforation is made in a position accentrical in relation to the two others, then the data of three systems can be placed on one card, and be used for control.

Printing of the number systems on the cards described above does not necessarily have to be done on one side of the card, but one side can be used for one system, and the other side for the other system.

Since number printing is only an auxiliary for the eye during reading, and since the representation of the perforations can be done in number printing by the known automatic adding machines with printing aggregates, it is also possible to use cards without any printing at all.

All according to whether the cards must be used for the control of machines with pin boxes, or with electrical activation with a brush which slips over the card, or with any other sensing member, in some of the cards shown devices are necessary, which take care that selectively only

those perforations of one or the other perforation system can influence the organs of the machine.

These devices have been described below for above machine systems separately, after first having indicated in which manner the punches are arranged for punching of one or the other number system.

In the simple hand punch in which the card is placed in a frame and is stepwise carried beneath ten punch bars which are placed alongside each other, and which are provided with buttons for pressing them down, it must be possible that the card is secured in the frame in such a manner, that the numbers of the particular system according to which the perforations are made arrive below the punch bars. In Figs. 6, 6ª, 6ᵇ such an apparatus has been shown. The numbers: 1 represent the punch bars placed alongside each other, which perforate the card 3 when the buttons 2 are pressed. This card is held between the abutments 4, which in the stationary frame 5 are stepwise guided in known manner simultaneously upon pressing of a punch bar by means of a rack gear 6, 7 and a tension spring with locking wheel placed in the frame 8. The card is laterally guided by the bars 9_a, 9_b. The abutments 4 are [fol. 381] settable and the bars 9_a and 9_b are exchangeable, with the result that the card 3 can be placed beneath the punch bars 1 in such a manner, that the perforations can be made in the correct number system. The bars 9_a and 9_b can also be replaced by angle irons 10 on the abutments 4 (Fig. 6b).

In order to perforate the cards according to Figs. 1, 2 and 5, only one exchange of the bars 9_a and 9_b is necessary, and the latter must be dimensioned in such a manner that a change of the position of the card vertically to the direction of its movement is possible at the rate a_1–a_2. In order to make perforations as shown by Figs. 3 and 4, a shifting of the parts 4 in the direction of the movement of the card at the distance = b_1–b_2 must be made.

As is known, the mechanical punches have a card receptacle, a box with punch bars, with matrix and a card ejection receptacle, as well as mechanical drive for automatic card conveying, and for driving the punches. They are, therefore, related to the known mechanical sorting and adding machines mentioned further below, in which a pin box stands in the place of a box with the punch bars. The things that have been said there about the possibility to

shift the card bin, and about the movable abutments at the pin box, also goes for the mechanically operated punch.

Mechanically Operated Adding and Sorting Machines (Pin Box Machines)

In Figs. 7 and 7ª a pin box adding machine of the known kind has been described in front and side elevation (sic: schematic plan view and side elevation). The cards in the card bin 11 are referred to by number 3, which cards are singly fed from the lower part of the stack to the conveyor rollers 13 and 14 by the gripper 12, and these rollers transport them to the pin box 15 where they are prevented from further movement by the abutment 16. The pin box 15 receives an oscillating movement, by the fact that the two rollers 17 secured to it are guided by the curved groove 18 of two cam discs 20 which are keyed on the shaft 19 driven by a motor. By means of two gear wheels 21 on the same shaft 19 and a connecting rod 22, as well as a double lever 23, the card gripper 12 is driven. If the movement goes upward, the pins of the pin box 15 enter through the perforations of the card and raise the translator wires 25 connected to the members of the adding machine 24. When the pin box 15 is lowered, the abutment 16 is lowered with it, and the card 3, which the latter has retained until now, can be moved further and is conveyed to the ejection receptacle 27 by the rolls 14 and 26.

[fol. 382] When normal cards with ten horizontal number rows are used, the card bin 11 and the abutment 16 are set up in such a manner, that the cards are placed in the pin box in such a way that the position of the numbers printed on the cards resp. the perforations correspond to the pins. Hereby the bi-sector line of the card bin 11 and of the pin box 15 coincide. The abutment 16 has been placed at the same distance from the far outside row of pins, as the far outside row of numbers is distanced from the card edge.

Below it has been indicated, in which manner the card bin 11 and the abutment 16 must be shifted for selectively operating both systems in order to give the cards the proper position in relation to the pins. Both positions are shown in drawn out, and in dotted lines in Figs. 7 and 7ª.

In the cards according to Fig. 1, both number systems are placed symmetrically in relation to the bi-sector of the

cards. The card bin 11, therefore, continuously remains in normal position. The abutment 16, however, must be settable in the direction of the card movement for a step $= a_1 - a_2$ in order to make it possible that every time the correct perforations arrive over the pins.

For cards according to Fig. 2 the above said also is valid, however, the cards are introduced into the machine after having been turned around 180° in order to operate according to the second system.

Cards according to Fig. 3 require that the abutment 16 can be moved in the same way. Since the distance between the bi-secting lines of both systems $= b_1 - b_2$ resp. $\frac{1}{2}\ c_1$ (Fig. 3^a) the card bin 11 must be movable to this extent in a direction vertical to the direction of the card movement.

For cards according to Fig. 4, the abutment 16 also must be movable a distance $= a_1 - a_2$. The card bin 11 is immovable for both systems, but its bi-secting line is a distance of $\frac{1}{2}\ (b_1 - b_2)$ resp. $\frac{1}{4}\ c_1$ alongside the bi-secting line of the pin box, and this on the strength of the following relation.

The bi-secting line of one system is at a distance of the bi-secting line of the other system equaling $\frac{1}{2}\ c_1$, or since $\frac{1}{2}\ c_1 = b_1 - b_2$ the result is that the distance of the bi-secting lines, $= (b_1 - b_2)$. The common bi-secting line of both systems is placed symmetrically in the middle between the bi-secting lines of the systems, and is, therefore, at a distance $= \frac{1}{2}\ (b_1 - b_2)$ from these. In order to make the bi-secting line of the card bin 11 correspond to the bi-secting line of one system, it must be moved laterally at a distance of $\frac{1}{2}\ (b_1 - b_2)$. Since the card for operating the other sys- [fol. 383] tem is introduced into the machine after having been turned 180°, the bi-secting line of the corresponding system again falls on the same side of the common bi-secting line. The bin 11, therefore, remains for both systems laterally moved at a distance $= \frac{1}{2}\ (b_1 - b_2)$. In the case of the card shown in Fig. 4, this displacement is to the left in relation to the movement of the card.

The card shown in Fig. 5 with perforations of both systems placed eccentrically has resulted from the solutions 1 to 4 by contracting the numbers resp. perforations. In relation to the movability of the card bin 11 and the abutment 16, the things said for card 1 are valid in this case.

The explanations which refer to mechanical adding machines with pin boxes, mentioned above are also valid for

the mechanical sorter with a row of pins, and also for the mechanically operated punch in which a punch bar box is present in place of a pin box. The things said above, for machines with mechanically operated pin boxes, are logically used also for pin box machines in which the pins, which enter through the cards, close electrical contacts instead of starting a mechanical movement.

Electrically Operated Adding Machines and Sorters (Machines with Contact Brushes)

As is known, these machines have contact brushes or contact springs beneath which the card is passed, and which close a circuit at that moment, at which the brush comes in contact through a perforation with a metal piece or a metal roller placed behind a card.

Since two perforations are placed underneath each other in the cards shown in Figs. 1 to 5 arrangements must be made that a closed circuit can only be made through the perforation of the system according to which the card is used. Moreover, the brushes must be movable in a direction vertical to the movement direction of the cards in such a manner that in the case that cards, according to Figs. 3 and 4, are used, the brushes can be set up on the bi-secting lines of the vertical columns of either one or the other system.

The electrically operated statistical adding machine has been shown schematically in Figs. 8 and 9 in order to show [fol. 384] how the perforations of the system which selectively is not to be used, are electrically made inactive.

The reference number 3 in Fig. 8 shows the cards which are singly taken by the knife 28 and singly fed to the bin 30 by the roller pairs 29. Hereby they move between contact 31 and brush 32, which are placed in an electrical circuit with the double brush 33, the relay 34 and a magnet 35 of the adding device. The drive of the mechanism is done from the shaft 36. The knife 28 is driven by gears 37, a connecting rod 38 and a lever 39. Furthermore, a ring 40 with ten metal strips 41 and ten isolation strips 42 is secured to shaft 36 by means of a screw 43. This screw permits setting of the ring at the angle degrees of the strips 41, 42, with the result that the times for closing the current and the times for interrupting the current can be exchanged. In this manner, it can be obtained that the

brush 32 can give contact with the contact 31 selectively through the perforations of one or those of the other system, that, therefore, a perforation of the system which should not influence the registration of the machine does not give a closed circuit if it passes the brush first. The task of the relay 34 is to keep the circuit closed over the contact 44 at the moment when current flows through this relay, until after the card has passed through the contact 45, keeps the circuit open so long until a new card is placed between the brush and the contact. Similarly as in the case of machines with pin boxes, as described above, also here the card bin is movable in a direction vertical to the direction of the card movement in order to enable the brushes to pass over the middle of the perforations for cards according to Figs. 3 and 4.

A result of the various distances of the perforations of the same value from the card edge in the different systems, is that the closed circuit for a certain perforation e. g. for perforation 5 in one system, takes place sooner resp. later than for the perforation of the same value in the other system. Since such a timed shift of the circuit closing times makes it possible a correct activation of the adding resp. sorting mechanism which rotate synchronically with the drive of the whole machine, the card must be led through the contact device advanced if one system is used, and retarded through the contact device if the other system is used. For this purpose an advance resp. retardation of the card gripper at a_1–a_2 is brought about by changing the engagement of the gear wheel 37 which drive the card knife 28 (Fig. 8).

Instead of the advanced or retarded circuit closing by bringing about advancing or retarding by changing the gearing, it is possible to arrange the bar which holds the brush 32, or another sensing member so that it can be shifted in the direction of the card movement at a dis- [fol. 385] tance = a_1–a_2.

In the electrical sorter in which only one brush passes on a rotating contact roll and in which all according to the timing of the circuit-closing different deflectors of the sorting receptacle are open, also a rotating contact ring and isolating strips can be used. It is, however, simpler to provide the rotating contact roll 46 (Fig. 9) with isolating

strips 47 and to make the roll movable on the shaft by means of a screw 48 in such a manner that circuit closing with the brush 50 can always only take place at the perforations of one system of card 3. The brush is movable in a direction vertical to the direction of the card movement, in such a manner that it can be set up for each standing column in the card.

Two other solutions will be described below which make it possible to use one and the same card several times.

The method of solving this solution is by using punches resp. pins of different form for the first resp. second resp. third use of the card.

Fig. 10 shows a card with circular concentric perforations with diameters of different sizes. For the first use, perforations with a small diameter are perforated, for the second use of the card, larger punch bars are placed in the punches and for use in the cards, correspondingly thick feelers are placed in the pin boxes of the sectors and adding machines.

In Fig. 11 a card has been shown which differently from the normal circular shape of perforation has slotted perforations, which are placed horizontally for one use and vertically for a second use. Also in this case pins of different form are necessary for the pin boxes, in order to use both systems after each other.

Economical Advantages

Introducing the above described punched cards brings about a saving of paper to the extent of 50%, which especially will become very important in those cases when large numbers of cards are used. Since the expenses for the cards amount to over 60% of the total yearly expenses for such installations, using the above described cards with different systems of perforations represents a yearly saving of about 30%. Using such cards will, therefore make possible the introduction of the punched card system and the statistical machines also in those places where, until now, it did not pay owing to the high expenses for the machines and the cards.

[fol. 386] The above mentioned percentages are increased if cards are used with three perforation systems like the one shown in Fig. 5[a].

Patent Claims

1. Procedure to evaluate statistical data by means of perforated cards, characterized by using cards which are provided with two different systems of numbers resp. perforations to be used one after another for control, one of which is placed in those intermediary spaces which must remain free of perforations in consideration of the necessary distance of the perforation pins (for mechanically operated machines) or a consideration of the necessary timed period between sensing two perforations which are placed behind each other (in electrically operated machines).

2. Procedure according to claim 1, characterized in that the perforations resp. numbers of one system are placed in the intermediary spaces of the numbers of the vertical columns of the other system and whereby the succession of perforations resp. numbers from 0 to 9 goes in both systems from above and beneath (Fig. 1).

3. Procedure according to claim 1, characterized in that the perforations resp. numbers of one system are placed in the intermediary spaces of the numbers of the vertical columns of the other system, and whereby the succession of numbers resp. perforations from 0 to 9 in one system occurs from above to beneath and in the other system after rotating the card 180° also from above to beneath (Fig. 2).

4. Procedure according to claim 1, characterized in that the perforations resp. numbers in one system are placed vertically beneath resp. vertically above the intermediary spaces between neighboring perforations of the other system, and whereby the succession of the perforations from 0 to 9 in both systems goes from above to beneath (Fig. 3).

5. Procedure according to claim 1, characterized in that the perforations resp. numbers of one system are placed vertically beneath resp. vertically above the intermediary spaces of neighboring perforations of the other system, and wherein the succession of perforations resp. numbers from 0 to 9 in one system goes from above to beneath, and in the other system also goes from above to beneath after the card has rotated 180°.

[fol. 387] 6. Procedure according to claim 1, characterized in that the perforations of the same meaning of both sys-

tems are eccentrically placed in relation to each other (Fig. 5).

7. Device for statistical punching machines with carriage which receives the card to be punched and which is moved beneath the punch bars for using punched cards according to claims 2 to 6, characterized in that the abutments 4 which determine the position of the cards in the carriage resp. the bars 9_a, 9_b (Fig. 6) which serve the lateral guiding, can be moved or exchanged in such a manner that the card which is to be perforated can be passed beneath the punch bars in such a position that perforations can be made according to one or the other system.

8. Device for statistical punches and sorting machines and adding machines, with a card receiving bin, an automatic card forward movement, an oscillating punch bar box resp. pin box, and a card ejection bin for using punched cards according to claims 2 to 5^b, characterized in that for selective usage of the cards according to one or the other system the card receiving bin (11 Figs. 7, 7^a) can be shifted in a direction vertical to the direction of the card movement and in that the abutment 16 which retains the card in the punch bar box resp. pin box can be shifted in the direction of the card movement.

9. Device for statistical adding machines and sorters with a card receiving bin, an automatic card forward movement, one or a plurality of brushes for electrically sensing the cards, and a card ejection bin for using punched cards according to claims 2 to 6, characterized in that the circuit which feeds the switching magnet of the machine is led over a contact device (40, 41, 42 Fig. 8) which all according to its setting makes possible a closed circuit for perforations of one system alone, or of the other system alone.

10. Device for statistical adding machines and sorters with a card receiving bin, an automatic card forward movement, one or several brushes for electrically sensing the cards, and one or several card ejecting bins for the purpose of using perforated cards according to claims 2 to 6, characterized in that the metal roll 40 which serves as countercontact for the brush is provided with isolation strips 42 and can be shifted on the driving shaft 36 in the direction of its rotation by virtue of which, all according to the setting of

the roll, a closed circuit is possible only for the perforations of one or the other system.

[fol. 388] 11. Device for statistical adding machines and sorters with a card receiving bin, an automatic card forward movement, one or several brushes for electrically sensing the cards, and a card ejection bin for using punched cards according to claim 2 to 6, characterized in that for selectively using the cards according to one or the other system, the knife for the cards can be set for advanced movement or retarded movement.

12. Device for statistical adding machines and sorters with a card receiving bin, an automatic card forward movement, one or several brushes for electrically sensing cards, and a card ejection bin for using punched cards according to claims 2 to 6, characterized in that for selectively using the cards according to one or the other system the bail which holds the contact brushes or the sensing member can be shifted in the direction of the card movement.

13. Alteration of the procedure according to claim 1 (when mechanically operated machines are used) characterized by the using of cards, which are provided with two different systems of perforations which are concentrically placed in relation to each other, and which have differently sized diameters for the single systems (Fig. 10).

14. Alteration of the procedure according to claim 1, characterized by the usage of cards which are provided with different systems of perforations which have a form different from the circular form and the bi-secting line systems of which have a different direction (Fig. 11).

15. Device for statistical punches, adding machines and sorting machines with a card receiving bin, an automatic card forward movement, a rocking punch bar box resp. pin box, and a card ejection pin for using punched cards according to claims 13 and 14, characterized in that the punch bar box resp. pin box can be provided with punch bars resp. pins of different form, or placed in different positions, according to the forms of the perforations of the system which is destined to be used.

Department of Commerce, United States Patent Office

To all persons to whom these presents shall come, Greeting:

This is to certify that the annexed is a true copy from the records of this office of the Complete Specification and Drawing, in the matter of the British Letters Patent to Henry Harris Lake, dated June 17, 1902, Number 13,751, for Improvements in Perforated Music Sheets.

This certified copy ordered by the Department of Justice.

In testimony whereof I have hereunto set my hand and caused the seal of the Patent Office to be affixed, at the City of Washington, this twelfth day of November, in the year of our Lord one thousand nine hundred and thirty-five and of the Independence of the United States of America the one hundred and sixtieth.

Conway P. Coe, Commissioner of Patents. (Seal.)

Attest: D. E. Wilson, Chief of Division.

N° 13,751 A.D. 1902

Date of Application, 17th June, 1902—Accepted, 21st Aug., 1902

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PATENT OFFICE.

COMPLETE SPECIFICATION.

Communicated from abroad by THE AEOLIAN COMPANY, a corporation organized and existing under the laws of the State of Connecticut, & having a place of business at 18 West 23rd Street New York City, United States of America, Manufacturers.

"Improvements in Perforated Music Sheets."

I, HENRY HARRIS LAKE, of the Firm of Haseltine, Lake & Co., Patent Agents, 45 Southampton Buildings, in the County of Middlesex, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

The invention relates to improvements in perforated music sheets which are to be used in automatic musical instruments.

The object of the invention is to enable a person operating a mechanical musical instrument, for the purpose of accompanying a singer or player of a musical instrument, or for playing a song, to follow the singer or player accurately in tempo and expression, and also to permit the player or another person to sing or play a musical instrument directly from this music sheet while it is being used on the mechanical musical instrument.

In the accompanying drawing a part of the improved music sheet is shown.

On the sheet A, are produced two staves B and C having bars corresponding to the treble and bass clef respectively. These staves extend in the direction of the length of the music sheet and their lines are separated a distance corresponding to the transverse distances between the lines of perforations. On these staves and between the bars the notes of the melody are printed in the conventional manner, and perforations or slots *a* are cut into this sheet so that when the sheet is used on a mechanical musical instrument it will cause the instrument to produce the melody represented by the notes printed on the staves.

The beginning of each slot or perforation preferably coincides with the position of the note that it represents. Instead, the printed notes may be before, above or below the staff or staves.

In the direction of the length of said staves, the words of a song are produced and are so spaced as to correspond to the position of the notes pertaining to such words, in the conventional manner of writing song music. This music sheet can thus be used by a singer at the same time that this sheet serves to produce the desired sounds on a mechanical musical instrument by means of its perforations as the words of the songs are produced on the sheet and are in proper position in relation to the music. The person operating the mechanical musical instrument has before him representation of the notes pertaining to the several slots and also the words pertaining to the notes and can thus gauge his tempo and expression of playing to correspond fully to that of the person singing the melody, or the player can sing while playing and can readily gauge his tempo and expression to the words as he sings them.

In addition to the words or instead of the words notes for a musical instrument or instruments may be produced on the music sheet.

[Price 8d.]

Having now particularly described and ascertained the nature of the said invention and in what manner the same is to be performed, as communicated to me by my foreign correspondents, I declare that what I claim is: —

1. As a new article of manufacture, a music sheet for mechanical musical instruments, having produced on its face musical staves and bars, notes on said staves, and perforations in said sheet, the beginning of each perforation being within the note to which the perforation pertains, substantially as set forth.

2. As a new article of manufacture, a music sheet for mechanical musical instruments, having produced on its face musical staves and notes therein, perforations in said sheet, the beginning of the perforations being within the notes to which said perforations pertain, and words of a song produced on said sheet along one of the staves, substantially as set forth.

3. As a new article of manufacture, a music sheet for mechanical musical instruments having produced therein a musical staff and bars, perforations in said sheet some of which register with the lines and spaces of said staff, and notes produced on said staff to indicate the tones of the perforations registering with the staff.

4. As a new article of manufacture, a perforated music sheet having produced thereon a staff and bars and notes on said staff which indicate some of the perforations of the music sheet.

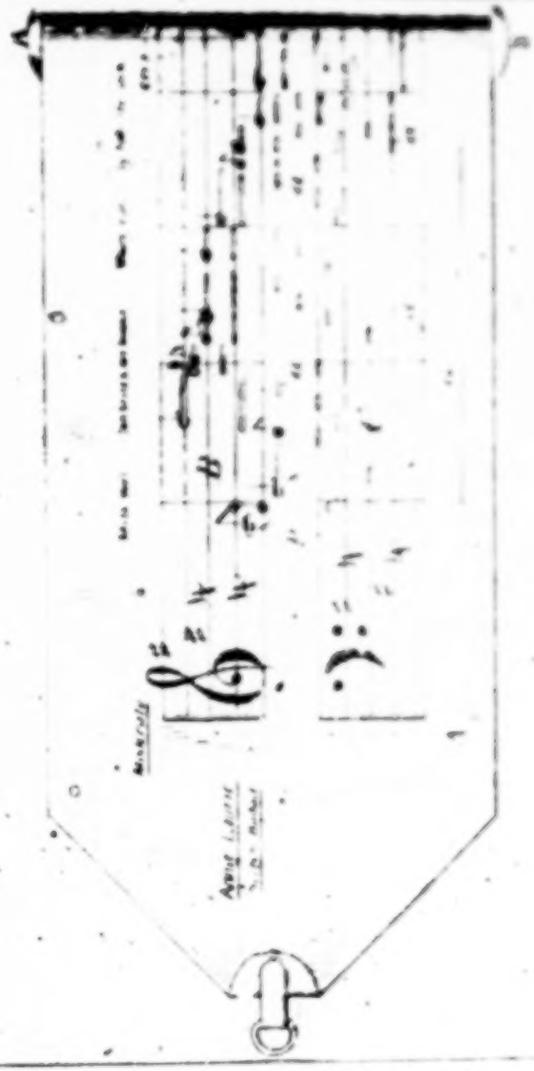
Dated this 17th day of June 1902.

HASELTINE, LAKE & Co.,
45 Southampton Buildings, London, W.C.,
Agents for the Applicant.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1902.

[This Drawing is a reproduction of the Original on a reduced scale.]

(1 SHEET)



A.D. 1902. JUNE 17. No. 13,751.
LAKES Complete Specification.

(No Model.) 9 Sheets—Sheet 1.

H. HOLLERITH.

TABULATING SYSTEM.

No. 518,885. Patented Apr. 24, 1894.

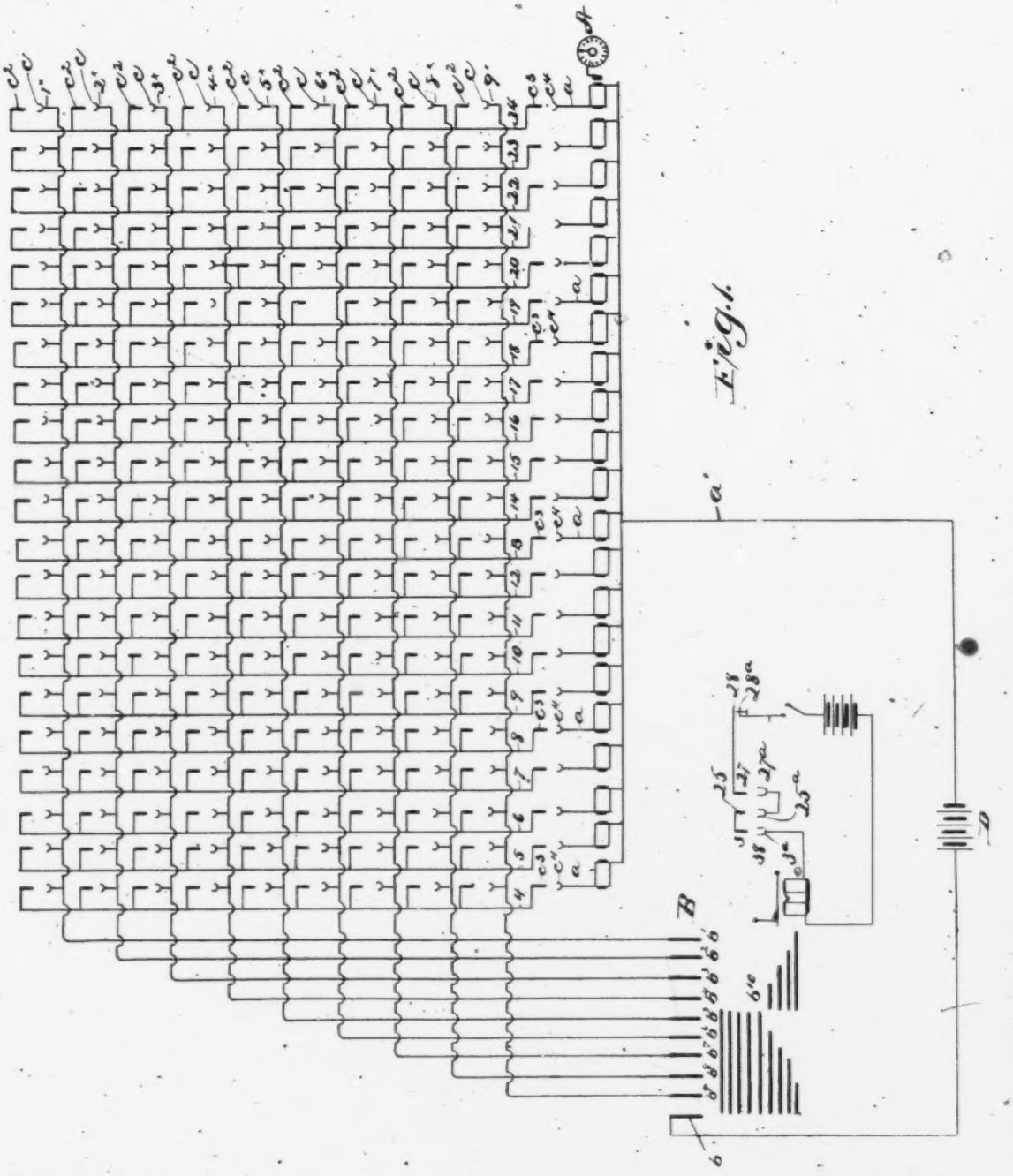


Fig. 1.

Witnesses.
J. M. Fowler Jr.
Thomas Durant

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His Attorneys.

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TABULATING SYSTEM.

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Fig. 2.

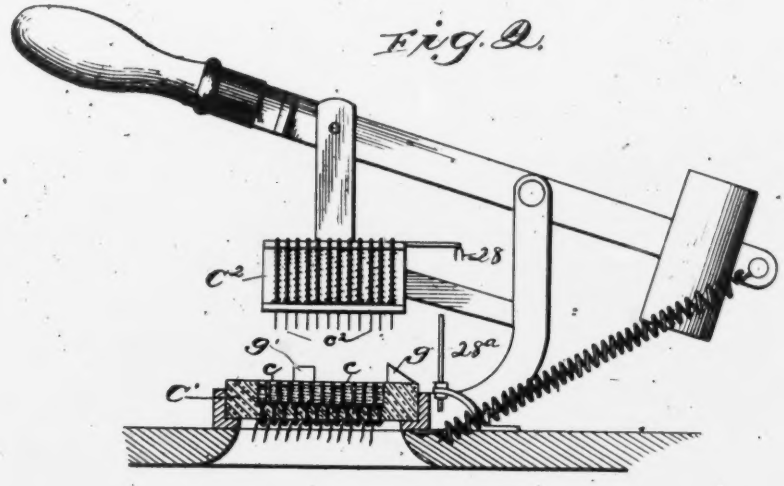

Fig. 3.

Witnesses

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His Attorneys.

(No Model.) 9 Sheets—Sheet 3.

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TABULATING SYSTEM.

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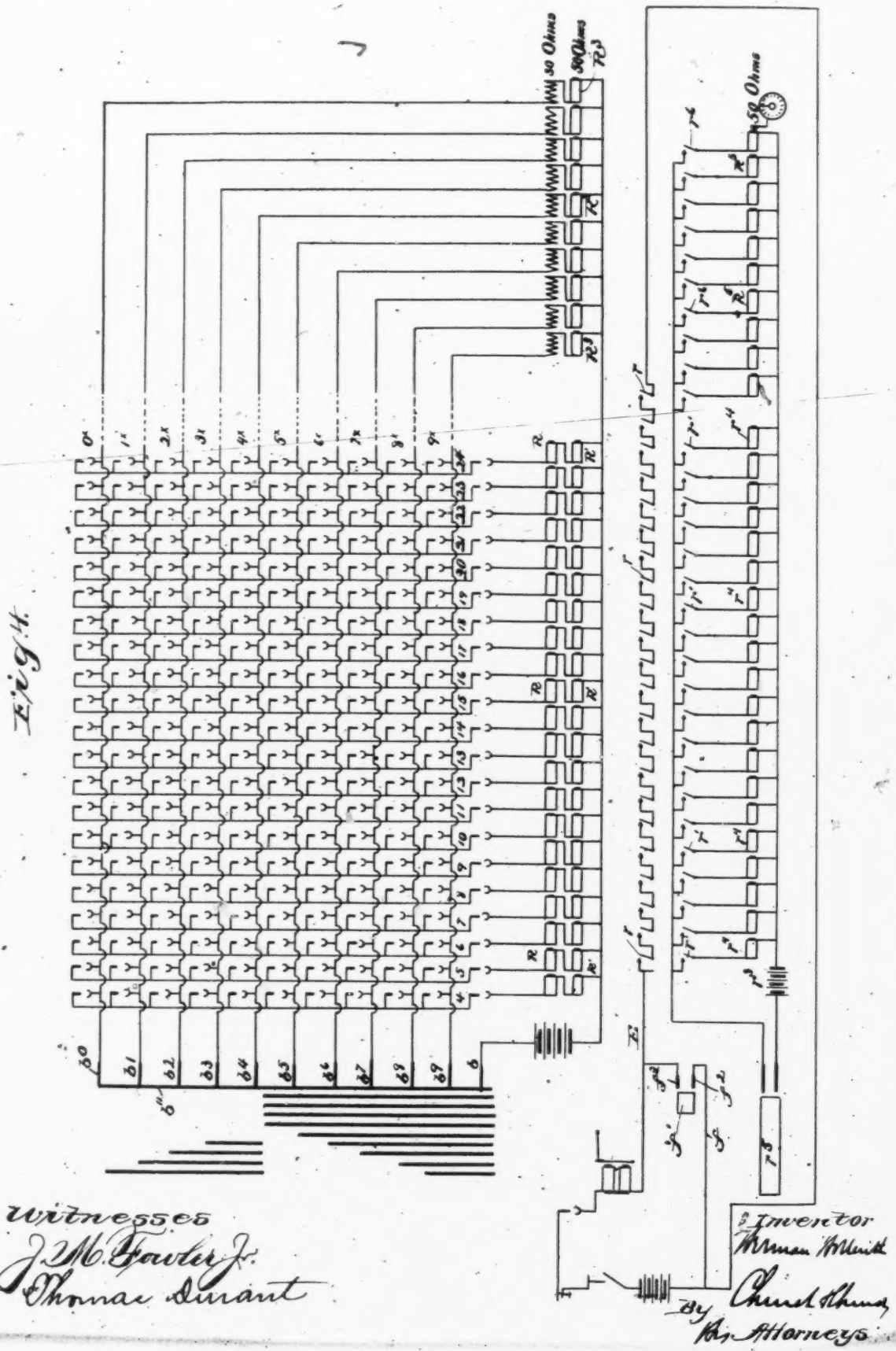

Fig. 4.

Witnesses
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(No Model.) 9 Sheets—Sheet 4.

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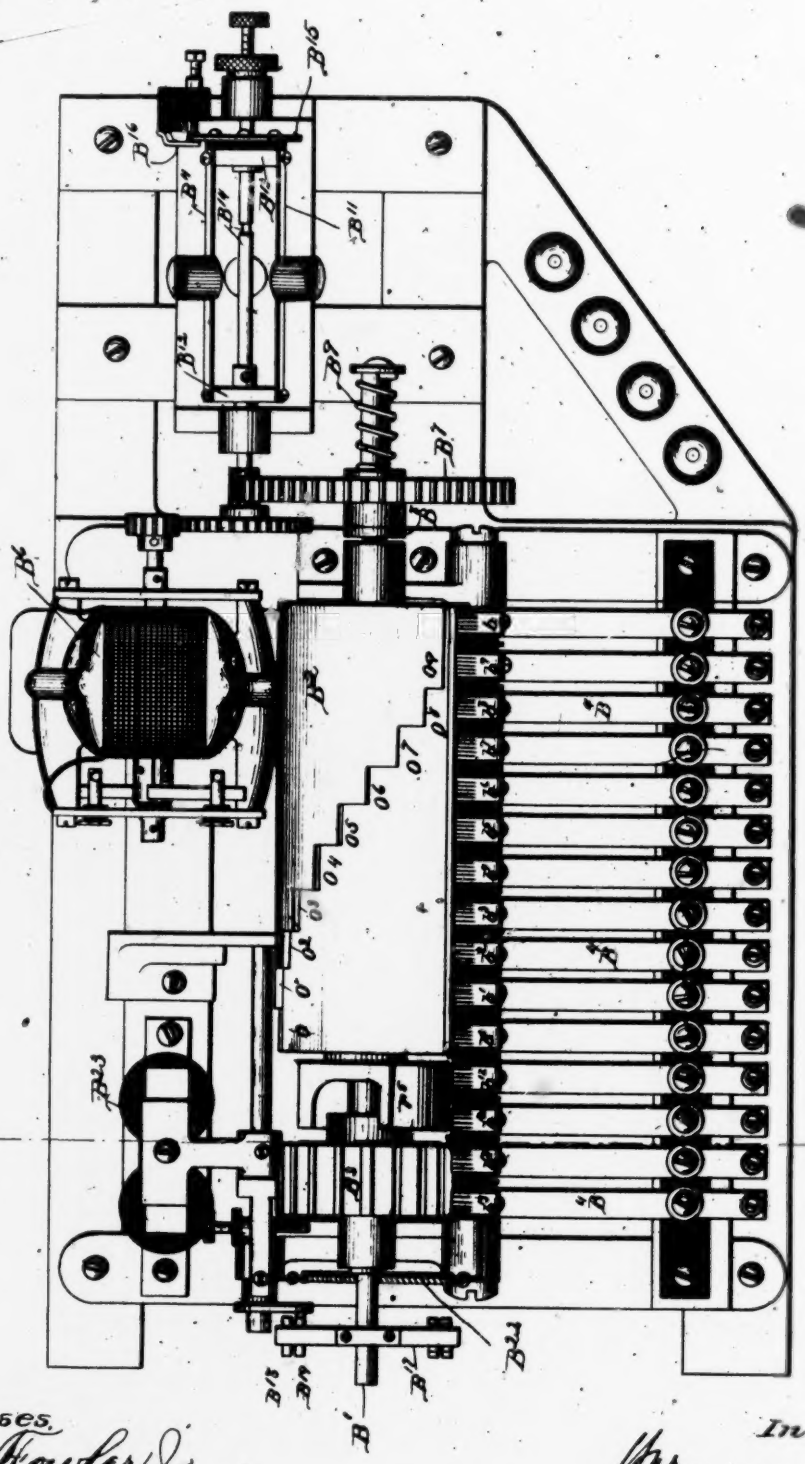

Fig. 5.

Witnesses.
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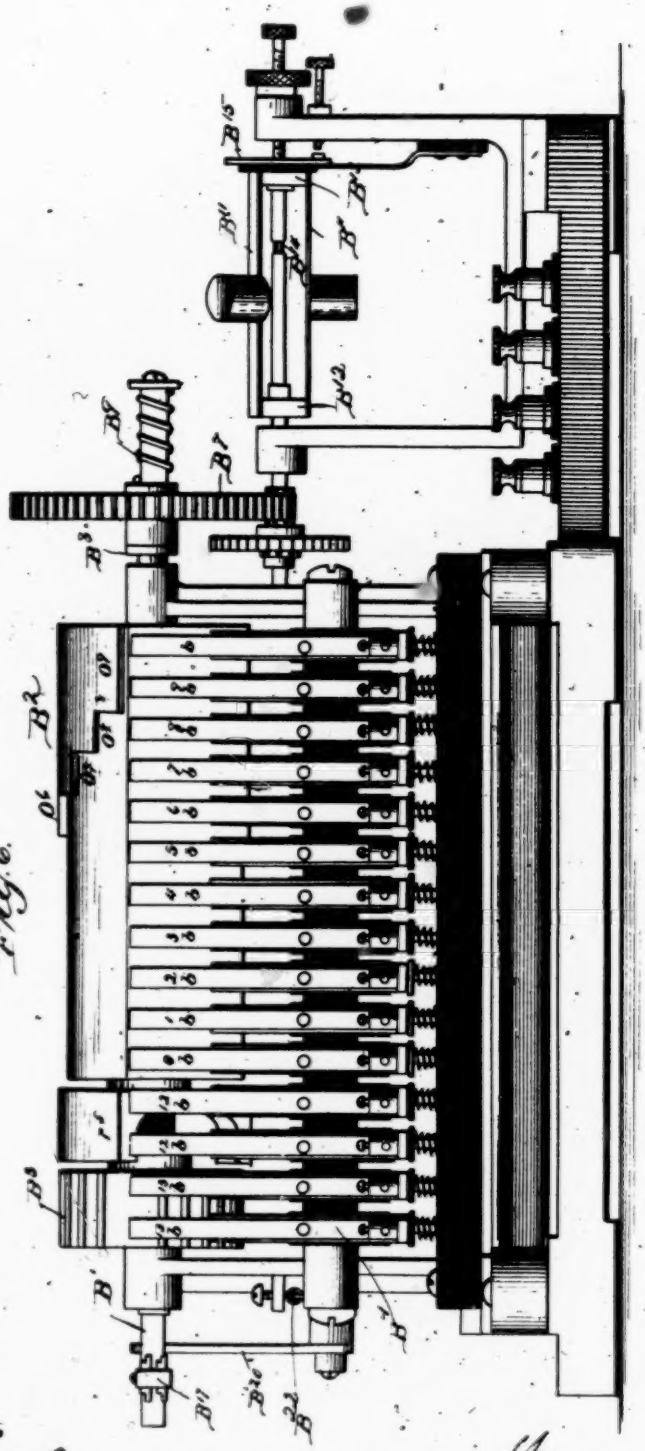

Fig. 6.

Witnesses
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TABULATING SYSTEM.

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Fig. 7.

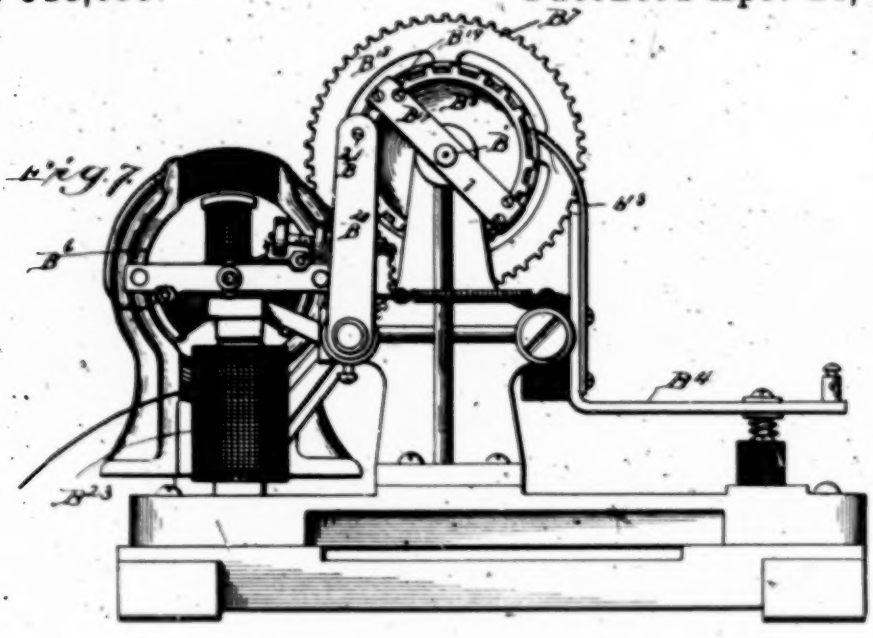
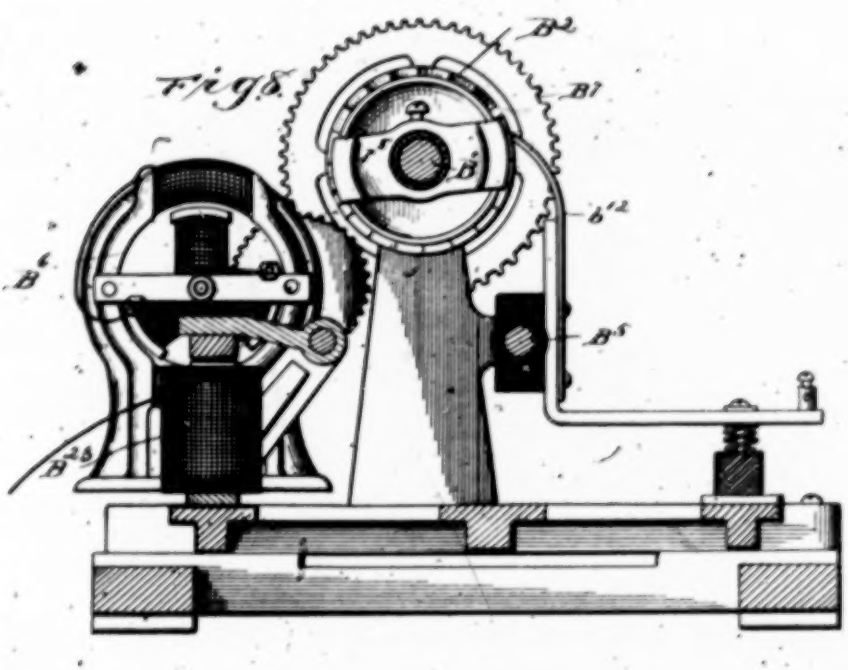


Fig. 8.



Witnesses
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(No Model.) 9 Sheets—Sheet 7.

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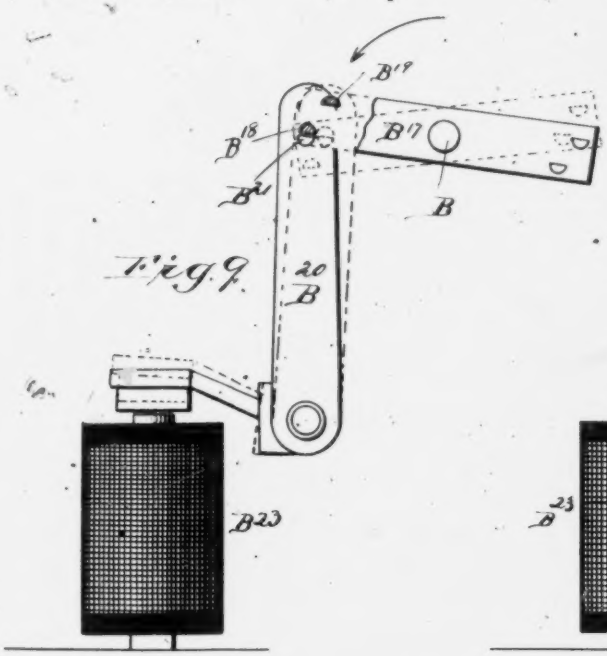

Fig. 9.

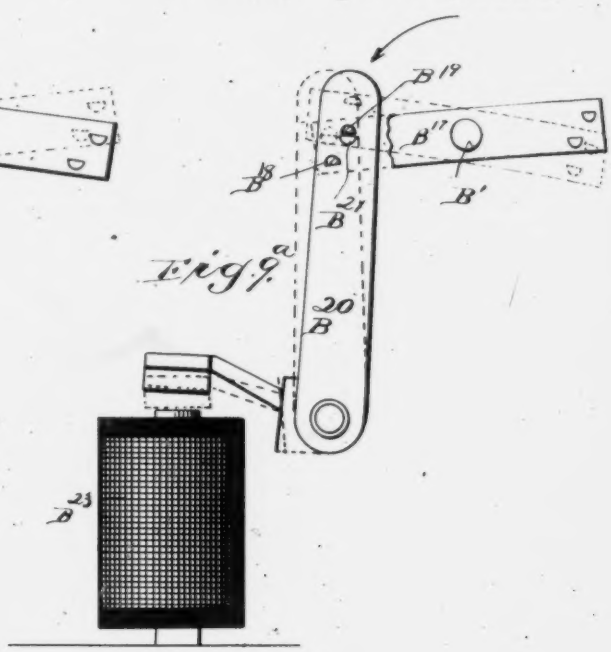

Fig. 9a.

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(No Model.) 9 Sheets—Sheet 8.

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TABULATING SYSTEM.

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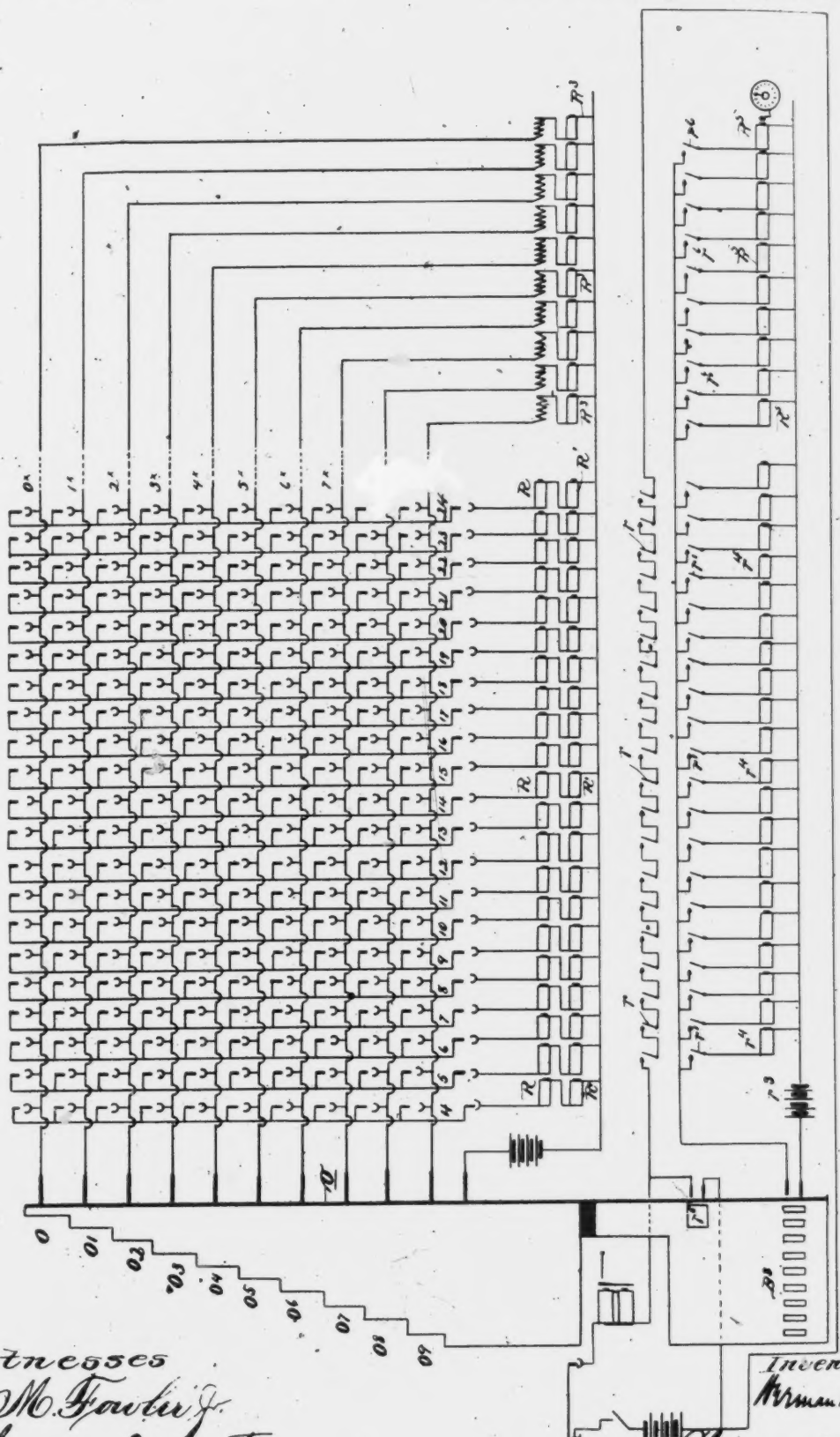

Fig. 10.

Witnesses
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Herman Hollerith.

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his Attorneys.

(No Model.) 9 Sheets—Sheet 9.

H. HOLLERITH.

TABULATING SYSTEM.

No. 518,885. Patented Apr. 24, 1894.

Fig. 11.

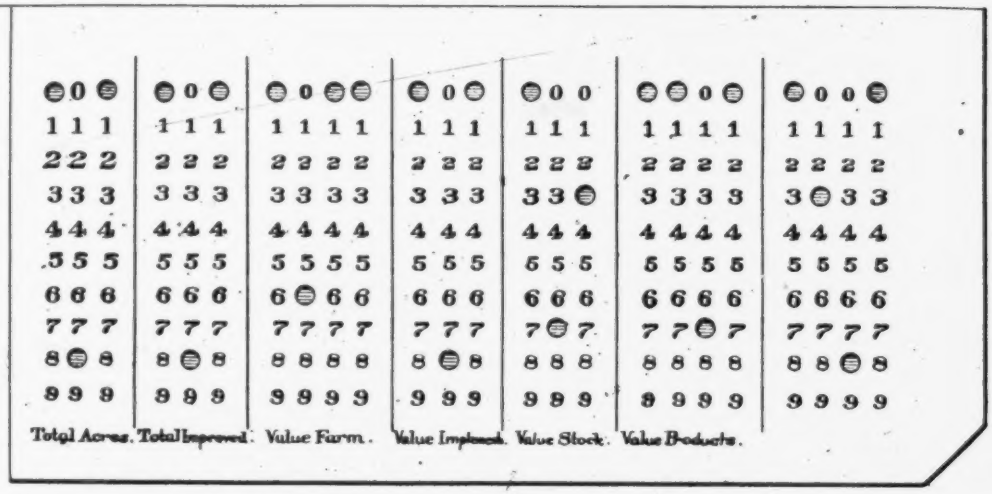


Fig. 12.

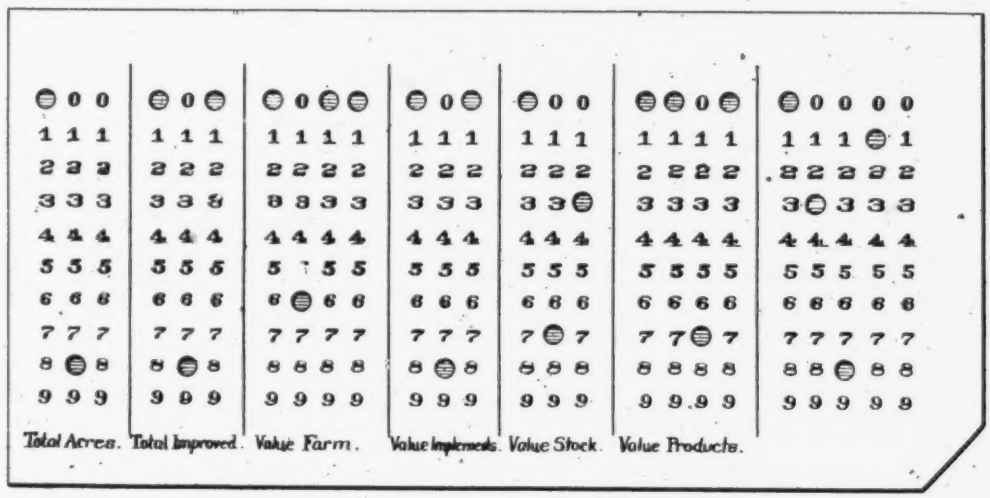
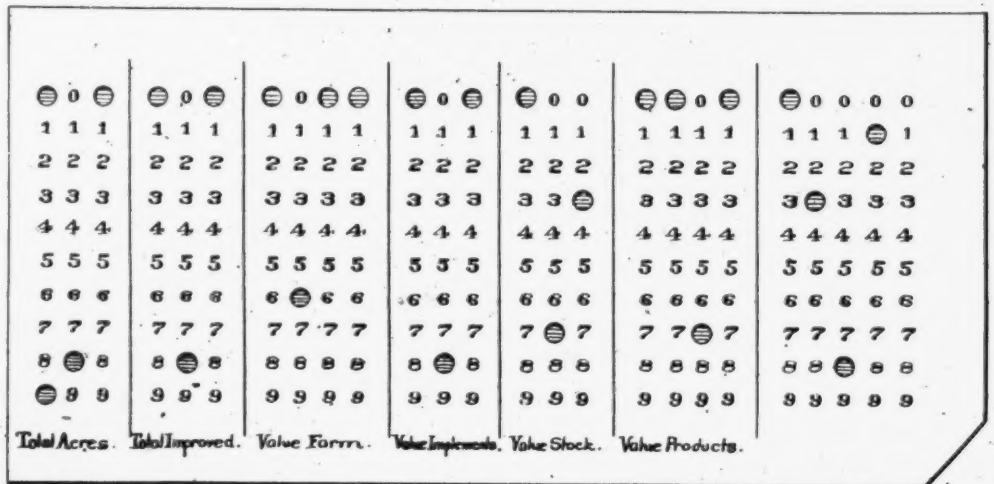


Fig. 13.



Witnesses:
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Inventor:
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Attorneys

UNITED STATES PATENT OFFICE.

HERMAN HOLLERITH, OF WASHINGTON, DISTRICT OF COLUMBIA.

TABULATING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 518,885, dated April 24, 1894.

Application filed August 1, 1893. Serial No. 482,097. (No model.)

To all whom it may concern:

Be it known that I, HERMAN HOLLERITH, of Washington, District of Columbia, have invented certain new and useful Improvements in Tabulating or Calculating Systems; and I do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming a part of this specification, in which—

Figure 1 is a diagrammatic view of one of the primary embodiments of my system. Fig. 2 is a vertical sectional view of the switch mechanism, the record card being omitted. Fig. 3, is a plan view of a record card. Fig. 4 is a diagrammatic view illustrating another embodiment of the system; Fig. 5, a top plan of an improved form of integrator mechanism; Fig. 6 a front elevation; Fig. 7 an end elevation, and Fig. 8 a cross sectional view of the same on line x—x Fig. 5. Figs. 9 and 9^a are detail views of a portion of the detent mechanism. Fig. 10, is a diagrammatic view illustrating the application in the system of the improved integrator mechanism shown in Figs. 5 to 9. Fig. 11 is a plan view of a properly punched record such as designed for use in connection with the embodiments of the system shown in Figs. 4 and 10. Fig. 12 is a plan view of a record card which has been insufficiently punched. Fig. 13 is a similar view of an overpunched card.

I have invented what I believe to be certain novel and highly useful improvements in tabulating or calculating systems, and in order that the higher developments of the invention may be more readily apprehended, I will premise by describing one of its primary forms, reference being had, for this purpose, to Figs. 1 to 3, of the accompanying drawings.

This embodiment of my invention, shown in said figures involves the use of the following instrumentalities: first, a series of independent electrically controlled counters or registers and appropriate circuit connections; secondly, an integrator capable of producing in each series of circuit connections leading therefrom a different number of electrical impulses or interruptions; thirdly, a switch mechanism controlling communication between the several circuit connections leading from the integrator and the circuit connections leading to the several counters or registers; and, fourthly, an actuating or master circuit closed by the movement of the switch mechanism, and controlling the starting and stopping of the integrator.

The switch mechanism as shown in Figs. 1 and 2 comprises a fixed bed plate C′ provided with insulated contacts or terminals c in the form of mercury cups or equivalent contacts, and a movable platen, or what I prefer to call "pix box" C^2 carrying yielding pins or contacts c^2. The pin box is provided with suitable guiding and supporting means, and is held normally elevated, while a lever or other actuating device is provided for depressing it to bring the contacts c^2 into engagement with the contacts c.

The connections to be made through the switch mechanism are regulated and determined by a record card or strip—Fig. 3—provided with perforations (p) disposed according to a prearranged plan, interposed between the fixed and movable sections of the switch mechanism, so that, as the movable section or pin box is depressed, only those of the movable contacts or pins c^2, which descend in line with the perforations p in the record card will be permitted to pass through the card and engage with their co-operating contacts c in the bed plate and thus close the circuits with which they are connected, all other contacts c^2 being held back and their circuits kept open by the bodily interposition of unperforated portions of the record card or strip as will be readily understood. The contacts c are electrically connected in groups $1^\times$ to $9^\times$ inclusive (see diagram Fig. 1) and the contacts or pins c^2 are also connected in groups numbered 4 to 24 inclusive, arranged at right angles to the groups $1^\times$ to $9^\times$, there being at least nine contacts in each group, so arranged and disposed that one contact c^2 of each of said groups 4 to 24 will be opposite one contact c of each group $1^\times$ to $9^\times$. Each group of contacts $1^\times$ to $9^\times$ is connected to one of the contacts or brushes b' to b^9 of the integrator B, Fig. 1, while each group of contacts 4 to 24 is connected to one of the counters or registers A through the circuit connection a leading to the magnet of said counter or register, the magnets of all the registers being connected to a common return conductor a' having in

terposed in it a generator D and terminating in a contact or brush b at the integrator.

Instead of forming permanent connection between groups 4 to 24 (the movable contacts of the switch) and the several register circuit connections a (as might be done) the former preferably terminate in pins or contacts c^3 carried by the movable pin box and co-operate with contacts c^4 in the bed plate, said contacts lying outside the record card when the latter is in position, so as to always close the circuits whether any of the other contacts in the same group are permitted to pass the card or not.

The movable pin box is provided with four additional or supplemental contacts 3, 25, 27 and 28, (Fig. 1) of which the first three have to do with the proper location of the record cards on or in the switch mechanism. Contacts 3 and 25 occupy positions along one edge of the pin box, opposite the side gage or gages g g, and just beyond the margin of the record card when in position; while contact 27 is located at one end just beyond the record card opposite the end gage g'. As thus arranged if the record card is properly located it will not interfere with the descent of any of the contacts, but if shifted out of proper position, it will lie in the path of one or more of the contacts, and prevent further advance on the part of the contact thus engaged. These three contacts 3, 25 and 27 are located in the same circuit and all three must be in contact with the opposite electrodes or contacts 3^a 25^a and 27^a to close the circuit, hence if any one is held back the circuit will remain open and the apparatus inactive, inasmuch as said contacts are located in what may be termed a master or starting circuit, which, in the present instance, includes the devices for setting in motion the integrator through which the several operating circuits extend. The contact 28 is also carried by the movable pin box and co-operates with the contact 28^a on the base; it, too, is located in the master circuit and is adjusted to effect the final closing and first opening of the circuit in which it is located, so that all the sparking in that circuit will occur at this one point where it can be most easily controlled and its injurious effects provided against.

The integrator B (shown diagrammatically in Fig. 1) is an apparatus for producing in each of a series of circuit connections leading to groups $1^\times$ to $9^\times$ a different series of electrical impulses of such form, duration and character as to affect the registering devices to advance them as many steps or units as there are electrical impulses sent over the particular circuit at the time including the particular register. In the example given, contacts or brushes b' to b^9, inclusive, are the terminals of the groups of contacts $1^\times$ to $9^\times$ and they are arranged to be engaged intermittingly by a series of contacts or bars b^{10}, mounted upon a rotating cylinder driven by a suitable motor and provided with a detent mechanism, the latter controlled by a magnet e in the master or starting circuit. A contact or brush b forming one terminal of the generator circuit is also arranged to engage each of the contacts b^{10}, thereby completing the circuit through the latter and each of the contacts b' to b^9. The contacts or bars b^{10} are so arranged and disposed upon the cylinder that during a complete movement of the latter, *i. e.*, a complete or partial rotation, contact or brush b' will be engaged by but one of said contacts b^{10}; contact or brush b^2, by two contacts; b^3 by three, and so on throughout the series, the last contact or brush b^9, being engaged by nine contacts b^{10}.

The ultimate effect produced by one complete movement of the integrator is as follows: The master circuit being closed, the integrator cylinder is started and the current entering through contact or brush b, passes successively, through the contacts or bars b^{10} to contacts or brushes b' to b^9, and each of said last named contacts receives a different number of electrical impulses, from 1 to 9. If, now, any of the circuits through the switch mechanism be closed through the registers or counters, the latter will be advanced as many points as there are pulsations produced in its circuit, and the number of pulsations will be governed by the record card in placing any one of the contacts b' to b^9 in communication with that particular register. It will be observed that the contacts of each group of contacts $1^\times$ to $9^\times$ can be placed in communication with the contacts of any one or more of the groups of contacts 4 to 24 thus closing circuit connections through one or more of the register magnets, and that each group of contacts $1^\times$ to $9^\times$, through its connections with the integrator, receives and transmits a series of electrical pulsations corresponding to the assigned value of the group. Assuming, for the purpose of illustration, that the series of items embraced but the three groups of contacts 4, 5 and 6 (the number of contacts 4 to 24 apportioned to any given series of calculations being a matter of choice) and that the value to be registered or added is 562, the record card will be perforated at the fifth division from the top in the column corresponding to group 4, in the sixth division of group 5 and in the second division of group 6. The card having been properly located on the platen, when the pin box is brought down the circuit connections will be closed through the register magnets and integrator, and five pulsations will be sent through the register magnet belonging to group of contacts 4, six pulsations will be sent through group 5 and two through group 6, each register being advanced the number of digits represented by the perforations in the column of the record card belonging to that particular register. If the record card is not placed fairly in position on the bed plate so that the contacts 3, 25 and 27 will pass the edges, one or more of said contacts will engage the card, thereby preventing the

closing of the master circuit and the starting of the integrator, which fact will be observed by the operator who will thus be admonished that the record card is not properly adjusted. A check is thus provided for one source of errors, those liable to arise from the failure to properly position the record card so as to bring the several divisions in register with the contacts of the pin box, and if the records made on the record cards were absolutely accurate the system thus far described would be adequate for most purposes. But in actual operation it has been found that there are certain difficulties arising mainly from carelessness or inaccuracy on the part of the operator in preparing the record cards. First. The clerk whose duty it is to prepare the record card may fail to punch some of the digits representing items or values entering into the computation. Second. Two or more holes may be punched in one column (each column representing one of the groups of contacts 4 to 24) and none in another. Third. The card may be placed in the machine crooked, or the holes be punched out of position so that some pins which ought to go down will be held up, thus causing a failure to register. Fourth. Some pin or pins in the pin box may be broken or stuck, thereby preventing the closing of one or more of the circuits designated by the holes in the record card. Fifth. Two holes may be punched in one column while at least one hole is punched in every other column. Experience has amply demonstrated that these are not imaginary, but are actual difficulties certain to occur in practice, and are productive of serious results, so far as accuracy is concerned. In the first place, the omission of holes that should have been punched, the presence of broken pins, or the sticking of the pins, &c., will affect the results by the omission of a corresponding amount, *i. e.*, the value of the items not registered. When, however, two or more holes are punched in one column a rather startling result will be obtained. Suppose, for example, a hole is punched in every column corresponding to the value 1. Each counter should and ordinarily would register 1. If, however, in any column an additional hole is punched representing a higher value so as to make two holes in one column—then each counter instead of registering 1 will register according to the value of the additional hole of higher value. To illustrate: Suppose a hole is punched in the first and ninth divisions of the first column connecting groups $9^{\times}$ and 4 (see Fig. 1), nine impulses will be transmitted through the register magnet and the counter will be advanced nine points. If, at the same time, a hole is punched in the first division of the second column so that groups $1^{\times}$ and 5 will be connected, the magnet of the register belonging to the second column or group 5 instead of receiving one impulse only, as it should, will receive nine impulses, because the current transmitted through contact or brush b^9 will be conducted from group $9^{\times}$ through group 4 to group $1^{\times}$ and thence to group 5 and to the register magnet. Thus, the pulsations or impulses delivered to group $9^{\times}$ from contact or brush b^9 and designed to influence only such of the register magnets as are connected by holes in the ninth divisions of each column or group 4 to 24, are diverted onto the group $1^{\times}$, by the perforation in the first division, and are transmitted to all register magnets at the time connected with a contact in group $1^{\times}$ through a hole in the first division. It will be seen that if 1 and 9 be punched in any one column, every other 1 in the other columns will register 9, be it units, tens, thousands or millions. A corresponding improper registration will take place upon the forming of multiple holes in any column of the record card, the hole of higher value always dominating. With a view to overcoming the defects noted and thereby eliminating those errors due to the inaccuracy of the person who prepares the record card or strip, I have devised and invented certain improvements in the nature of modifications and extensions of the primary system, and especially designed first to prevent the registration of cards not containing at least one hole in each column, thus requiring the punching of a hole in each column in order to effect any registration whatever; and, secondly, to indicate a mistake resulting from double punching or the punching of more than one hole in any column of the card, thereby enabling a timely correction of the error to be made.

The improvements designed to detect record cards in which each column is not represented by at least one punched hole, or, in other words, to detect record cards bearing incomplete records will first be described. As may already have been anticipated, this feature of my invention is based upon and involves the punching of at least one hole in every column of the record card whether the hole punched represents a value to be registered or not, thus requiring that a hole be punched at some point in each column in order to render the card, as a whole, operative to actuate the registering mechanism. In carrying this idea into practice the first step involved is the provision of an additional series of divisions on the card (by divisions I mean prearranged locations on the card apportioned among the various items or series of items designated by the punched holes) one for each column representing say, 0, (see Figs. 11, 12 and 13,) which additional division or 0, is designed to be punched whenever there is no value to be recorded in the particular column. Thus if 60 is to be recorded on the card, the sixth division in the tens column will be punched and there being nothing in the units column to be recorded instead of skipping that column as heretofore, the 0 therein will be punched.

The next step is the provision of an addi-

tional group of contacts 0^x in the pin box (see diagrammatic view, Fig. 4) and the addition of one co-operating contact to each of the series of groups of contacts 4 to 24. These represent the additions to the switch mechanism. Such additions are not designed to directly affect the operator of the registers or counters, but merely the master circuit which controls the starting of the integrator, as will hereinafter more fully appear. The master circuit E includes a series of relay contacts r (Fig. 4) one for each group of contacts 4 to 24 and said relay contacts are controlled by relay magnets R connected in circuit with said series of groups of contacts, there being one such relay magnet and relay contact for each of said group of contacts.

To start the integrator the master circuit must be closed, and this can only occur when all the relay contacts are closed, hence if the circuit to any one or more of the relay magnets is not established, the master circuit will remain broken at one or more points, and the integrator will be prevented from being started when the pin box is depressed. The closing of the relay circuits requires that at least one hole should be punched in each column, and the omission to so punch each column will be at once indicated by the failure of the integrator to start when the pin box is depressed.

It is necessary that the switch mechanism should be so connected up with the battery that upon the descent of the pin box each group of contacts 0^x to 9^x will be in condition to close the circuits through the holes in the card and the series of groups of contacts 4 to 24, and this can conveniently be effected by providing the integrator with a contact or bar b^{11} so located and arranged that when the integrator is at rest, at the starting point, the several contacts or brushes b^0 to b^9 will rest upon said bar b^{11} and be in circuit with the battery through contact or brush b. Assuming now that a record card properly punched with a single hole in each column, as shown in Fig. 11, is properly placed upon the bed plate, and that the pin box is brought down a pin in each of the groups of contacts 0^x to 9^x, Fig. 4 will pass through the holes in the card and make contact with one or the other of the contacts in each of the series of groups of contacts 4 to 24, the result being the energizing of all the relay magnets R, the closing of all the relay contacts r, the completion of the master circuit E, the energizing of the starting magnet, the withdrawal of the detent from the integrator cylinder and the advance of the integrator cylinder under the influence of its motor or prime mover. Should, however, a card be introduced in which there has been a failure to punch a hole in one or more of the columns (as illustrated by the card in Fig. 12) or should any pin opposite one of the punched holes be stuck or broken, the bringing down of the pin box would fail to operate one or more relays, and this master circuit being thus left open at one or more points, the starting magnet would not be energized and the integrator would not be operated. As soon as the master circuit is closed through the series of relay and other contacts and the integrator commences to move, the contact bar b^{11}, through which all of the series of groups of contacts 0^x to 9^x are placed in communication with the battery, is withdrawn from the contacts or brushes b^0 to b^9, thus opening all the circuits through the switch mechanism, the continued movement of the integrator then operating to produce the electrical impulses in the circuits connected to contact strips b' to b^9, the contact strip b^0 not being reengaged till the integrator again reaches first position. With this arrangement, if the pin box remained depressed until the bar b^{11} again engaged the contact strips and closed the circuits through the switch mechanism, the detent would be a second time withdrawn, and the described operation of the apparatus repeated. To prevent this reregistration by the same card, the detent mechanism is provided with a second stop for arresting the movement of the integrator just before the bar b^{11} is brought into position to close the circuits through the switch mechanism, and this second stop is brought into action by closing the master circuit through a branch f which is closed by a contact f' mounted upon the integrator cylinder or otherwise moved in unison with it and engaging two brushes f^2 f^2 constituting the terminals of the branch circuit. This second detent serves to hold the integrator stationary so long as the master circuit remains closed through the branch f and until the pin box is elevated, breaking the master circuit and permitting the integrator to advance to the second detent, when the contact or bar b^{11} will again engage the contacts or brushes 0^x to 9^x, but no current will flow through the circuits owing to the elevation of the pin box. During this movement the branch circuit f is again opened, to be closed only after the integrator has been set in motion and has nearly reached the limit of its movement.

It will be observed that the circuits through the switch mechanism are utilized in controlling the starting of the integrator, the record card itself being the principal element in determining whether or not such starting shall take place. Provision having thus been made for starting the integrator, the registering of the various items designated on the record card may be effected as follows: Interposed in the circuit connection of each of the groups of contacts 4 to 24 is a second relay magnet R'. Each of these relay magnets R' controls a relay contact r' in a circuit including a generator r^3, a register magnet r^4 and a circuit closing device r^5. For convenience, the several relay contacts and their register magnets are arranged in multiple arc with a single generator r^3 and circuit closer r^5, the

arrangement being such that when the circuit closer closes the circuit and one or more of the relay contacts is or are closed, the register magnet or magnets of the closed relay contact or contacts will be energized and the register or registers operated once for each closure. Inasmuch as the relay magnets R′ are arranged in the same circuits with the relay magnets R, which latter effect the starting of the integrator, provision is made for preventing the movements of the registering devices when the circuits through the switch mechanism are closed for starting the integrator, and in the present instance this is accomplished by the employment of the circuit closing device r^5 which operates to connect the several register magnets with the generator when their relay contacts are closed. To this end the circuit closing device r^5, in the form of a contact strip is arranged to move in unison with the integrator cylinder and is so located with relation to the contact bar b^{11} that when the latter is in engagement with the contacts or brushes b^0 to b^9 the circuit including generator r^3 will be open and no current can pass through the register magnets when their relay contacts are closed. After the integrator has been started and contact bar b^{11} has been withdrawn, and before the integrator contacts or bars b^{10} are brought into action to send electrical impulses through the switch mechanism, the circuit closing device r^5 engages or closes the circuit connections leading to battery r^3 and holds said circuit closed while the integrator contacts or bars b^{10} are acting, thereby placing the battery r^3 in communication with the several register magnet circuits so that each time the relay contacts are closed an electrical impulse will be transmitted through the register magnet. The circuit closer r^5 opens the circuit or disconnects the battery after the last integrator contact or bar b^{10} passes beyond the contact strips 1^x to 9^x, and before the latter re-engage the contact or bar b^{11}. The integrator having been started, as hereinbefore explained, each relay magnet R′ closes its relay contact as many times as there are electrical impulses transmitted from the integrator through the circuit closed through the switch mechanism including the particular relay magnet; and the number of pulsations or impulses transmitted through any one of the relay magnets R′ is determined entirely by the location of the hole in record card through which any contact in groups 1^x to 9^x is connected to any contact in the groups 4 to 24.

It will be noted that in the first described embodiment of my invention the electrical impulses or pulsations which directly affect the register magnets are transmitted by the integrator through the circuits of the switch mechanism; and in the second or later described embodiment such impulses or pulsations are likewise transmitted through the circuits of the switch mechanism, but instead of acting directly upon the register magnets, operate through relays to open and close a local circuit in which the register magnets are interposed. I prefer however to employ an integrator mechanism by which the circuits through the switch mechanism will be held closed, and the relays will operate to close local circuits through which a predetermined number of electrical impulses are transmitted for the purpose of energizing the register magnets. Such mechanism is represented in Figs. 5 to 9, inclusive and diagrammatically in Fig. 10. Upon a shaft B′ is mounted a cylinder provided with a stepped or graduated plate of conducting material B^3. Upon the same shaft, but insulated therefrom and from each other, are mounted the contact plate r^5 and a circuit breaking wheel B^2. Independent insulated brush holders B^4 are mounted upon a rod B^5, and each of said brush holders is provided with a limiting screw and a spring for adjusting it in proper position. The contacts or brushes b b^0 to b^9 are secured to this series of brush holders, and in addition thereto two pairs of contacts or brushes b^{12} and b^{13} are provided, the brushes b^{12} representing terminals of the branch f of the master circuit, while the brushes b^{13} b^{13} form terminals of the register circuit.

The circuit breaking wheel B^2 is formed or provided with a series of nine teeth or projections, and the conducting plate B^3 is formed of varying width in the direction of the motion of said plate, so that the several contacts or brushes will remain in contact with said plate during a longer or shorter interval; thus, the contact or brush b^0 co-operates with the narrowest portion 0, the contact brush b' with the next under portion 0′ and so on throughout the series except that the brushes b^9 and b both engage the widest section 0^9.

The motor device preferably employed for actuating the integrator is an electric motor B^6 designed to run continuously so as to furnish a constant source of power, said motor being connected to the integrator shaft through a suitable train of gearing and a friction driver represented in this instance by the gear B^7 whose hub is held against a fixed collar B^8 on the shaft by an adjustable tension spring B^9, so that when the integrator shaft is arrested the gear B^7 will continue to be driven by the motor, but be always ready to rotate the shaft when the latter is released.

In order to impart steadiness to the running of the motor it is preferably provided with a governor consisting essentially of a series of spring arms B^{11} weighted at their middles, and connected at one end to a fixed head B^{12} and at the opposite end to a head B^{13} movable upon a shaft B^{14} connected to the gear train, said movable head carrying an insulated disk B^{15} which, when the governing weights are thrown outward, engages a contact arm B^{16} included in the master circuit, and operates to break or weaken said circuit,

thereby interrupting or diminishing the power of the motor and slackening its speed until the circuit is again established.

The detent mechanism comprises an arm or projection B^{17} upon the shaft B', said arm being provided with two stop pins or shoulders B^{18} B^{19} arranged at different distances from the shaft and one slightly in advance of the other. An arm B^{20} provided with a pin or shoulder B^{21}, (moved in one direction by a spring B^{22} and in the opposite direction by the electro-magnet B^{23} in the master circuit), is so arranged that its shoulder B^{21} will alternately engage the stop pins or shoulders B^{18} B^{19}, that is to say, when the arm B^{20} is carried to one position by the energizing of the magnet B^{23}, its shoulder B^{21} will stand in the path of the pin or shoulder B^{18} and arrest the shaft; and when the master circuit is broken and the magnet de-energized the spring will retract the arm, removing its shoulder from in front of pin or shoulder B^{18}, and carrying it into the path of the more rearward pin on shoulder B^{19}, whereupon the shaft will be advanced slightly under the influence of the motor until said pin B^{19} engages the shoulder on the arm, where it will remain until the magnet B^{23} is again energized by the closing of the master circuit for starting the integrator.

I would here state that the base or foward edge *o* of the conducting plate B^3, Fig. 10, performs the functions of the conducting bar b^{11} of the integrator represented in Fig. 4, that is to say, it connects the battery through contact or brush *b*, with each of the contacts or brushes b^0 to b^9, so that each group of contacts $0^\times$ to $9^\times$ may be placed in communication with one of the relays R, through the holes in the record cards for closing the master circuit and starting the integrator. The narrowest portion 0 of the plate B^3 is of such width that it will be moved out of contact with the contact strip or brush b^0 before the brushes b^{13} b^{13} are engaged by the first tooth of the circuit breaking wheel B^5, consequently the circuit including brush b^0 is broken before the first impulse is sent through the register circuit. The circuits through contacts or brushes b' to b^9 remain closed so long as the said brushes bear upon the conducting plate B^3, and the circuits are broken successively after the passage of each tooth of circuit breaking wheel B^5, that is to say, the brush b' remains in contact during the passage of the first tooth, the brush b^2 remains in contact during the passage of two teeth, and so on throughout the series, the brush *b* retaining contact until the end of the plate is reached. It will thus be seen that the group of contacts $1^\times$ (see Fig. 10) will be connected to the battery while one impulse is being sent through the register circuit, after which said group will be cut out and those relays which are in communication with said group of contacts through perforations in the record card will be caused to open the local circuits, thereby preventing the passage of the next succeeding impulse from battery r^3 through said local circuit. Those circuits which are closed through the switch mechanism and include the contact strip or brush b^9 will remain closed and their relays will hold the local register circuits closed while two impulses are being sent through the register circuit, after which the circuits including the group of contacts $2^\times$ will be cut out and the local register circuits controlled by the relays will be broken. Thus after the passage of each tooth of the circuit breaking wheel B^5 one of the groups of contacts b' b^9 will be disconnected from the battery and such of the relays as are at the time connected in circuit will be operated to open its local register circuit and thus prevent the passage of any greater number of electrical impulses than are assigned to the particular group $1^\times$ to $9^\times$ which is cut out by the passage of its contact or brush b' to b^9 from off the conducting plate B^3. The contact plate r^5 is arranged to engage the brushes B^{13} before the circuit breaking wheel has completed its movement and it operates to energize the starting magnet B^{23} in the master circuit to arrest the movement of the integrator shaft as the circuit breaking wheel completes its motion thereby holding the integrator stationary after a complete registration has been effected and until the master circuit is broken by raising the pin box, when the integrator will be again advanced to the second stop B^{19} in position to be again operated and the brushes b^{13} will pass off the contact r^5.

I have described but a single conducting plate B^3, a single contact plate r^5, a circuit breaking wheel having only one series of nine teeth and but a single arm B^{20} with its two stops B^{18} B^{19} but it is obvious that these parts may all be arranged in duplicate and I have so shown them in the drawings Figs. 5 to 9.

Reference was made in the earlier part of this specification to a further improvement or extension of my system designed to detect the presence of a record card bearing duplicate holes in any one column, and I will now proceed to describe at length this feature of my invention. Such an overpunched card is shown in Fig. 13 where two holes are indicated in the first column. It will be observed, that each contact or brush b^0 b^9 either produces or controls the production of a different series of electrical impulses in the registering circuits, the series running from 0 to 9. For each of said brushes a separate tell-tale register is provided upon which is registered the number of impulses produced or controlled by that brush, whether said impulses so produced or controlled operate the other registers of the system or not. As also hereinbefore explained, whenever a card having two holes punched in any one column is acted upon, the pin passing through the hole of higher value will carry the current through the group of which it is a member to the pin

passing through the hole of lower value and thence to one of the groups of contacts 0^x to 9^x, thereby increasing the number of pulsations produced or controlled by said group of contacts of lower values and, to the extent of the increase, augmenting the number of points which should be registered by the register corresponding to the hole of lower value. This defect is common to both the systems described, that is to say, the system having the register magnets in the circuits of the switch mechanism and the system in which the registers are arranged in local circuits with relays in the circuits of the switch mechanism. Now, when such a false or improper registration is made the fact is indicated upon the tell-tale registers, I have referred to, that is to say, the tell-tale register belonging to the group of contacts into which the current has been diverted instead of indicating the number belonging to that group, or a multiple thereof, will indicate an increase equal to the difference between the number belonging to that group and the number of the group of higher value. For example, the tell-tale register belonging to group of contacts 0^x will normally make no registration; that belonging to group 1^x will indicate one point for each operation of the integrator; that belonging to group 2^x will indicate two points and so on, throughout the series, the tell-tale register of group 9^x indicating nine points. If, now, two holes are punched, say, in the first and ninth divisions of any one column, group 9^x will be placed in communication with group 1^x and a series of nine impulses will be produced in the register circuit containing the tell-tale register belonging to group 1^x and the register will be advanced nine points instead of one. Upon observing the fact that the tell-tale register belonging to group 1^x indicated nine points when it should have indicated but one the operator would know at once that a card having duplicate holes in one column has been acted upon, and that the holes were located in the first and ninth divisions of the column, because the tell-tale register or group 1^x indicated eight points more than it should normally, and the increase (8) above the normal (1) added to the latter, indicates the hole of higher value in the column containing the one hole.

There are numerous ways in which the tell-tale registers can be connected up to do this work and adapted to operate with various styles of integrators and an illustration is given of a preferred plan in Figs. 4 and 10, wherein the tell-tale registers are shown arranged for operation with the two forms of integrator mechanism hereinbefore described. Referring first to Fig. 4, a separate branch circuit is provided for each tell-tale register, each branch including, when closed through contacts or bars b^{10} b^{11}, one of the contacts or brushes b^9 b^9, a generator and a relay magnet R^3. These several branch circuits being connected to contacts or brushes b^9 to b^9, either directly or through the groups of contacts 0^x 9^x as shown, each receives through the integrator the same number of electrical impulses as its corresponding group of contacts 0^x 9^x, that is to say, the branch connected to contact or brush b^9 and belonging to group of contacts 0^x receives a single impulse (when in contact with bar b^{11}); the branch connected to contact or brush b' and belonging to group of contacts 1^x receives two impulses; and so on throughout the series, the branch connected to b^9 receiving ten impulses. It is to be remembered, however, that the first impulse transmitted through contact bar b^{11} while the integrator is at rest, is not a counting but merely a starting impulse, hence it follows that the several branch circuits will be closed and the relay magnets R^3 energized at the same time that the relay magnets R and R' of the master and register circuits are energized, but the period during which the counting is effected begins after the integrator has started, the contact bar b^{11} withdrawn and the circuit closer r^5 has placed the register circuits in connection with the battery or generator r^3. The magnets of the several tell-tale registers R^3 are placed in separate circuits or branches, each including the contacts r^6 of one of the relay magnets R^3, and the several tell-tale circuits or branches are placed in communication with the generator r^3 through the circuit closer r^5 after the contacts or brushes b^9 b^9 have passed the contact bar b^{11}. If the record card is properly punched, that is, has one hole in each column, every complete movement of the integrator will occasion the advance of each tell-tale register, with the exception of that one connected to group of contacts 0, as many points as there are produced electrical impulses in the group of contacts 1^x to 9^x to which it is connected, whether or not a register circuit is at the same time closed through the contacts of said group; and the passing of a number of record cards, say ten, through the switch mechanism will be indicated as 10 on the tell-tale register of group 1^x; 20 on tell-tale of group 2^x; 30 on tell-tale register of group 3^x; and so on through the series of tell-tale register of group 9^x indicaitng 90 because during ten complete movements of the integrator 90 operative or counting impulses have been sent into group of contacts 9^x through the contacts or bars b^{10} of the integrator. Suppose the eleventh record card had two holes punched in one column, say the 0 and 9 in the first column, and one hole in every other column; the nine impulses sent through the group of contacts 9^x would be transmitted to the branch circuit containing the relay magnet R^3 of the group of contacts 0^x and the tell-tale register would indicate nine points, when it should not indicate any if the card were properly punched. If the record card contained holes in say the fourth and sixth divisions of one column, six impulses would be sent through the tell-tale register of group of contacts 4^x and said tell-

tale register would show forty-six points instead of forty-four, the two points above the normal indicating that the duplicate holes are in the fourth and sixth divisions of a column, the first indicated by the tell-tale register on which the irregular number is shown, and the second, by adding the excess, two, to the normal, four showing that the irregular registration was due to the connection formed between the fourth (4^x) and sixth (6^x) groups of contacts.

The described arrangement of tell-tale registers and circuits can be used in connection with the modified and improved integrator mechanism as represented in Fig. 10, wherein the circuits of the relay magnets are closed and remain closed a shorter or longer time according to the value or number of the digits, while the counting impulses are produced by the circuit breaker in the register circuits. In this case, the branch circuit containing the relay magnet of tell-tale register belonging to group 1^x will be held closed while one impulse traverses the circuit of the tell-tale, after which said branch circuit will open and the relay contacts being separated the register circuit will be broken so that succeeding impulses in the register circuit will not affect the tell-tale register.

In the foregoing description, I have described a system employing electricity as the motive power for effecting the several connections through the switch mechanism and operating in the register circuits, but I do not desire to be limited strictly thereto as it is obvious that fluid pressure may be employed in lieu thereof as clearly indicated in my application, Serial No. 456,066, filed December 22, 1892. I would also state that the primary form of the system herein described and illustrated in Fig. 1, forms the subject of a separate application, to wit, application Serial No. 454,674, filed by me December 9, 1892, and the same is not herein claimed.

Having thus described my invention, I claim as new—

1. The combination of a switch mechanism controlled by a record card, a series of independent circuits each containing a relay and connected with said switch mechanism and a normally open independent local circuit including the circuit controlling devices of said relays arranged in series; substantially as described.

2. In a system, such as described, the combination with the controlling record card or strip, the switch mechanism and circuits controlled thereby, of a relay included in each switch circuit and a normally open master or starting circuit including a series of circuit controlling devices operated by the relays of the switch circuits.

3. In a system, such as described, containing an integrating mechanism, a switch mechanism controlling a plurality of circuits and a starting or master circuit, the combination therewith, of a series of relays controlled by the switch circuits and having their circuit controllers arranged in the master or starting circuit.

4. In a system, such as described, containing an integrating mechanism, a switch mechanism controlling a plurality of circuits and a starting or master circuit, the combination therewith of a series of relays controlled by the switch circuits and having their circuit controllers in the master or starting circuit and a device for setting in action the integrating mechanism controlled from the master or starting circuit.

5. In a system, such as described, the combination of the following elements: an integrating mechanism, a switch mechanism controlling a plurality of circuits, a motor; a master circuit, a detent mechanism controlled from the master circuit and a relay included in one of the switch circuits and having its circuit controller in the master circuit.

6. In a system, such as described, the combination of the integrating mechanism, a master or starting circuit, a motor, a detent mechanism provided with a magnet in the master circuit and a circuit including the magnet of the detent mechanism and a circuit closer operated by the integrator mechanism to effect a second movement of the detent mechanism.

7. In a system, such as described, the combination of the following elements, an integrating mechanism, a switch mechanism having two series of groups of contacts one of said series communicating with the integrator and the other with circuit connections containing relay magnets, a circuit closer such as the bar b^{11}, a detent mechanism for the integrator, a master or starting circuit including the magnet of the detent mechanism and the contacts of the relays, and a separate or branch circuit including the magnet of the detent mechanism and a circuit closer operated by the integrator mechanism.

8. In a system, such as described, the combination of a switch mechanism provided with two series of groups of contacts and a record card or strip controlling communication between the respective series of groups of contacts, a magnet connected to each group of contacts of one series and a switch, operating periodically to connect all the groups of the other series of contacts with the generator.

9. In a system, such as described, the combination of a switch mechanism provided with two series of groups of contacts and a record card controlling communication between the contacts of the two series, a relay magnet connected to each group of contacts of one series, an integrator mechanism controlling the flow of current through the circuits of the switch mechanism and a series of local register circuits each including the contacts of one of the relay magnets.

10. In a system, such as described, the combination of the integrator mechanism; the

switch mechanism; the series of relays in circuit with the switch mechanism, a series of local register circuits each including the circuit controller of one of the relays and a circuit closer operated by the integrator mechanism to connect the local register circuits with a generator or source of power.

11. In a system, such as described, the combination of the switch mechanism provided with two series of groups of contacts and a record card; a series of relay magnets in circuit with the switch mechanism; an integrator mechanism controlling the flow of current through the circuits of the switch mechanism, a switch or bar for simultaneously and preliminarily closing all the circuits through the switch mechanism; and a series of local register circuits each including a relay contact and a circuit closer forming part of the integrator mechanism.

12. In a system, such as described, the combination of a switch mechanism adapted to be controlled by a record card, a series of relays connected to the switch mechanism; a series of local register circuits each controlled by one of said relays and an integrating mechanism controlling the transmission of current or power through the switch mechanism circuits and through the local register circuits respectively.

13. In a system, such as described, the combination of the following elements: a switch mechanism whose circuits are controlled by a record card; a series of relays connected to the switch mechanism; a series of local register circuits controlled by said relays; an integrator mechanism controlling the transmission of the current through the local register circuits and provided with a detent or starting mechanism; and a master circuit controlled by relays connected to the switch mechanism and operating upon the starting or detent mechanism to inaugurate the movement of the integrator mechanism when the switch mechanism circuits are closed.

14. In a system, such as described, the combination of the following elements: a switch mechanism comprising two series of groups of contacts and a record card; a series of relay magnets connected to one of the said series of groups of contacts; an integrator mechanism connected to the other of said series of groups of contacts and provided with means for simultaneously closing all of the several circuits through the switch mechanism; a series of local register circuits controlled by the said relay magnets and by the integrator mechanism; and a master or starting circuit for the integrator mechanism controlled by relays included in the several circuits through the switch mechanism.

15. In a system, such as described, the combination of the following elements; a switch mechanism whose circuits are controlled by a record card; a series of relays connected to the switch mechanism, a series of local register circuits controlled by said relays; an integrator mechanism controlling the passage of currents through the local register circuits; a detent mechanism for starting the integrator mechanism operating to arrest the integrator mechanism at intervals during one complete movement; a master or starting circuit controlled by relays connected to the switch mechanism and a separate or branch circuit controlling the detent mechanism and in turn controlled by the integrator mechanism, whereby after the integrator mechanism has been set in motion by the closing of the circuits through the switch mechanism it will be arrested before arriving at the starting point and held until the circuits through the switch mechanism are opened.

16. In a system, such as described, the combination of the following elements; a switch mechanism controlled by a record card; a series of relays connected to the switch mechanism; an integrator mechanism controlling the passage of current through the circuits of the switch mechanism and the relays; a series of local register circuits arranged in multiple arc with a generator circuit; and a circuit closer forming part of the integrator mechanism operating to complete the generator circuit.

17. In a system, such as described, the combination of the following elements; a switch mechanism controlled by a record card; two series of relays connected to the switch mechanism, an integrator mechanism controlling the passage of current through the circuits of the switch mechanism and the relays; a series of local register circuits arranged in multiple arc with a generator circuit, each of said local register circuits being controlled by one of the said relays; a master or starting circuit controlling the movements of the integrator mechanism and including the contacts of one of said series of relays arranged in series.

18. In a system, such as described, the combination of the following elements: a switch mechanism whose circuits are controlled by a record card, relays connected to the switch mechanism; an integrator mechanism and a master or starting circuit including two sets of contacts, the one controlled directly by the movement of the switch mechanism and the other by the relays.

19. In a system, such as described, provided with a switch mechanism an integrator mechanism, register circuits and a master or starting circuit for the integrator mechanism and in combination with said master or starting circuit, a mechanically operated circuit controller affected by the position of the record card and an electrically operated circuit controller in circuit with the switch mechanism, said circuit controllers cooperating to start the integrator mechanism.

20. In a system, such as described, the combination of a switch mechanism whose cir-

cuits are controlled by a record card, an integrator mechanism; a master or starting circuit controlling the movements of the integrator mechanism and two circuit controlling means connected to the master circuit one of said circuit controlling means being governed by the movement of the switch mechanism and the record card or strip and the other circuit controlling means being governed by the circuit connections of the switch mechanism.

21. In a system, such as described, the combination with the integrator mechanism and the switch mechanism, of a master or starting circuit for the integrator mechanism provided with a mechanically operated circuit controlling device and an electrically operated circuit controlling device, the former actuated by contact with the record card and the latter by the failure to close a circuit through the switch mechanism, to prevent the starting of the integrator mechanism.

22. In a system, such as described, the combination with the integrator, the switch mechanism whose connections are controlled by a record card and a master or a starting circuit through which the movements of the integrator mechanism are controlled of a contact carried by the movable section of the switch mechanism and included in the master circuit and a series of relay contacts also included in the master circuit and controlled by relays in the circuits of the switch mechanism.

23. In a system, such as described, the combination of the following elements; a series of register circuits; an integrator mechanism; a switch provided with two series of groups of contacts, the one connected to the integrator mechanism for controlling the production of different series of electrical impulses in the register circuits and the other connected to a series of relay magnets one for each register circuit; a master circuit through which the movements of the integrator mechanism are controlled, said master circuit containing two circuit controlling devices, the one operated directly by the movement of the switch mechanism and the other by the relay magnets; and a record card through which connection is made between the two series of groups of contacts of the switch mechanism, whereby, when the record card is properly placed between the members of the switch and the movable section of the latter is brought down, the circuit controller connected to the switch will close the master circuit at one point, and if the record card contains a hole in each column, the several relays will be operated to close the other circuit controlling device in the master circuit and start the integrator mechanism, but in case a card is not properly located or has not at least one hole in each column, the master circuit will not be completed and the integrating mechanism will be prevented from starting.

24. In a system, such as described, the combination of an integrator mechanism, a register circuit; a switch mechanism provided with a series of conductors, such as b' to b^9 connected to the integrator and each adapted to control the production of a different series of electrical impulses in the register circuit, an opposing conductor having a series of contacts, such as one of the group of contacts 4 to 24 and a record card by means of which communication is established between any one or more of the series of conductors and the opposing series of contacts; and a series of tell-tale registers one for each of said series of conductors, adapted to register the number of impulses controlled by said conductors, whereby at each complete movement of the integrator, the tell-tale registers will each indicate the number of impulses controlled by its conductor or circuit, and in the event that two contacts are connected with two of the series of conductors the tell-tale register belonging to the conductor of lower value will receive the number of impulses controlled by the conductor of higher value thereby indicating a defective record card.

25. In a system, such as described, the combination of a series of register circuits; an integrator mechanism adapted to control the production of different numbers of impulses in the register circuits; a switch mechanism provided with two series of groups of contacts the one series connected with the integrator and each group of said series controlling the production of a different series of impulses in the register circuits, the other series of groups of contacts serving to connect any one or more of the contacts of the first series and to designate the register circuit in which the impulses are to operate, and a record card for controlling the connections between the said two series of contacts; and a series of tell-tale registers one for each of the first mentioned series of groups of contacts.

26. In a system, such as described, the combination of the following elements: a switch mechanism provided with two series of groups of contacts and a record card controlling communication between the contacts of the two series; a relay magnet connected to each group of one series of contacts; an integrator mechanism connected to the other series of groups of contacts and controlling the flow of current to the circuits of the switch mechanism, a series of local register circuits each controlled by one of the relays and a series of local tell tale circuits each controlled by a relay connected to one of that series of groups of contacts which is in communication with the integrator.

27. In a system, such as described, the combination of the following elements, an integrator mechanism; a switch mechanism; a relay in a circuit controlled by the switch mechanism; a master or starting circuit for the integrator mechanism, including a contact controlled by the relay of the switch mechanism; and a series of local tell tale regis-

ter circuits controlled by relays connected to the switch mechanism.

28. In a system, such as described, the combination of the following elements, an integrator mechanism, a switch mechanism; a series of relays in the circuits controlled by the switch mechanism, a master or starting circuit for the integrator mechanism including the circuit controller of the relays arranged in series; a series of local register circuits; and a series of local tell-tale register circuits each controlled by a relay connected to the switch mechanism.

29. In a system, such as described, and in combination with an integrator mechanism, and a switch mechanism, the master or starting circuit provided with two circuit controlling devices the one operated mechanically by the switch mechanism and the other electrically through the circuits of the switch mechanism and the series of tell-tale registers controlled by the switch mechanism, whereby the starting of the integrator mechanism is prevented when the record card is incorrectly positioned, or not fully punched, and whereby also the overpunching of the card is indicated to the operator.

30. In a system, such as described, the combination of an integrating mechanism for producing different series of impulses, a series of register circuits, a switch mechanism for directing the transmission of any given series of impulses through any designated register circuit, and mechanism for automatically preventing the starting of the integrator mechanism when the record card of the switch mechanism is improperly placed or insufficiently punched.

31. A system, such as described, consisting of the following elements in combination, an integrating mechanism, a series of register circuits, a switch mechanism for directing the transmission of any given series of electrical impulses through any given register circuit; mechanism for automatically starting the integrator when the record card is properly positioned and fully punched; and devices connected with the switch mechanism for indicating overpunching of the record card.

32. In a system, such as described, the combination with the switch mechanism, the series of relays connected to one section of the switch mechanism a record card or strip controlling the latter and the series of contacts or brushes connected to the other section of the switch mechanism of an integrator formed or provided with a conducting plate, such as B^2 of varying width in the direction of the motion of said plate operating to close the circuits through the switch mechanism during different intervals.

33. In a system, such as described, the combination with the switch mechanism, a series of relays connected to one section of the switch mechanism and a series of contacts or brushes connected to the other section of the switch mechanism of the integrator provided with a conducting plate, such as B^2, of varying width, a series of local register circuits each controlled by one of the relays and a circuit breaker moving in unison with the said conducting plate and operating to produce electrical impulses in the local register circuits.

34. In a system, such as described, the combination with the switch mechanism, and its record card, a relay in circuit with the switch mechanism, an integrator provided with a conductor, such as B^2, for closing the circuits through the switch mechanism, a local register circuit controlled by the relay a circuit breaker moving in unison with the integrator conductor operating to produce electrical impulses in the local register circuit when closed by its relay.

35. In a system, such as described, the combination with the switch mechanism and its record card, a relay in circuit with the switch mechanism, an integrator provided with a conductor for closing the circuits through the switch mechanism during different intervals, a local register circuit controlled by the relay, a series of local tell-tale register circuits each controlled by a relay connected to the switch mechanism, and a circuit breaker for transmitting electrical impulses through the local register circuits and local tell tale register circuits while the latter are held closed by their relays.

36. In a system, such as described, as a means for controlling the movements of the integrator, the combination with the latter, of the detent mechanism, comprising the two stops carried by the shaft of the integrator, the arm engaging said stops alternately, a master or starting circuit, a branch circuit, circuit controlling devices for said circuits and the magnet in the master or starting circuit, said magnet being energized to start the integrator by the closing of the master circuit and again energized before the integrator completes its movement by the closing of the branch circuit.

37. In a system, such as described, the combination with the integrator, of the detent mechanism comprising the two stops carried by the shaft of the integrator, the arm engaging said stops alternately, a master or starting circuit, a branch circuit, circuit controlling devices for said circuits, and the magnet in the master or starting circuit controlling the movement of said arm, said magnet operating to start the integrator when the master circuit is closed through the switch mechanism, and to stop the integrator by the automatic closing of the branch circuit just before the integrator completes its movement.

38. In a system, such as described, the combination of the switch mechanism and the integrator, of a motor, a detent mechanism, a master or starting circuit, including a magnet controlling the detent mechanism and contacts controlled by the switch mechanism, said

magnet being operated by the closing of the master circuit to release the integrator and again operated by the closing of a second or branch circuit by the integrator to arrest the movement of the latter, said branch circuit including a contact connected to the switch mechanism and operating to open the circuit and permit the completion of the movement of the integrator upon the opening of the switch mechanism.

HERMAN HOLLERITH.

Witnesses:
J. C. STODDARD,
FRANK BARNARD.

[fols. 415 & 416] IN UNITED STATES DISTRICT COURT

[Title omitted]

STATEMENT OF OBJECTIONS OF UNITED STATES TO PORTIONS OF STIPULATION OF FACTS

Pursuant to the right expressly reserved to it in paragraph 2 of the Stipulation by and between the Petitioner and Defendants, International Business Machines Corporation and The Tabulating Machine Company, dated October 28, 1935 and filed in the Office of the Clerk of this Court on November 12, 1935, Petitioner, reserving to itself the right to make further objections, objects to paragraph (m) of said Stipulation and to each and every fact stipulated therein, as well as to all copies of letters patent filed with said Stipulation, or filed at the hearing in this cause pursuant to said paragraph, on the ground, among others, that the same are irrelevant and immaterial to the issues remaining in this cause under said Stipulation, and moves the Court to strike from said Stipulation and from the record herein to be considered by the Court in deciding said issues said paragraph (m) of said Stipulation and any and all copies of letters patent.

Dated November 18, 1935.

John Dickinson, Assistant Attorney General. Hammond E. Chaffetz, H. L. Godfrey, Geo. P. Alt, Special Assistants to the Attorney General.

[fol. 417] IN UNITED STATES DISTRICT COURT, SOUTHERN DISTRICT OF NEW YORK

E. 66/215

UNITED STATES OF AMERICA, Petitioner,

v.

INTERNATIONAL BUSINESS MACHINES CORPORATION; REMINGTON RAND, INC., The Tabulating Machine Company, and Remington Rand Business Service, Inc., Defendants

On final hearing in equity on an issue, severed from the other issues in this cause, involving the question whether

Title 15 United States Code, Section 14,—commonly called Section 3 of the Clayton Act—is applicable to certain restrictive covenants in leases of patented machines owned by defendant International Business Machines Corporation.

F. W. H. Adams, Esq., United States Attorney, and John Dickinson, Esq., Assistant Attorney General—by George P. Alt, Esq., Hammond E. Chaffetz, Esq. and Howard L. Godfrey, Esq., Special Assistants to the Attorney General, of counsel—for petitioner.

[fol. 418] Messrs. Davies, Auerbach & Cornell, attorneys for the defendant International Business Machines Corporation—by Edward Cornell, Esq., Drury W. Cooper, Esq. and Martin A. Schenck, Esq., of counsel.

Herman Schulman, Esq. was present throughout the proceeding before me representing David L. Podell, Esq., attorney for Remington Rand, Inc., but did not take any part whatever therein.

OPINION—Dec. 2, 1935

WOOLSEY, J.:

My decision herein is in favor of the petitioner which is entitled to the relief prayed for in the petition in respect of the issue tried before me.

I. The petition was filed on March 26, 1932, and charges against the defendants violations of the Act of Congress of July 2, 1890, 26 Stat. 209, commonly called the Sherman Anti-trust Act, and of Section 3 of the Act of Congress of October 15, 1914, commonly known as the Clayton Act.

The suit was originally begun by the United States against the International Business Machines Corporation and one of its wholly owned subsidiaries, The Tabulating Machine Company, and the Remington Rand, Inc., and one of its subsidiaries the Remington Rand Business Service, Inc.

Since the answers were filed herein The Tabulating Machine Company has been merged with the International Business Machines Corporation and the Remington Rand [fol. 419] Business Service, Inc. has been dissolved. Thus there are left as the only present defendants remaining in the cause: the International Business Machines Corpora-

tion, hereinafter called International, and Remington Rand, Inc., hereinafter called Remington.

II. The petition sets forth as Exhibit 1, an agreement made on March 4, 1931, between The Tabulating Machine Company and Remington which was the basis of the charges against both corporations of violation of the Sherman Anti-trust Act. On the practices followed pursuant to said agreement are based the charges of the violation of Section 3 of the Clayton Act by each defendant.

The several defendants duly filed answers putting in issue these charges.

Initially, therefore, three issues were involved in this cause, first, whether the defendants had jointly violated the Sherman Act, and, second and third, whether each of the defendants had severally violated Section 3 of the Clayton Act.

III. On October 28, 1935, there were three stipulations entered into between the parties.

1. A stipulation severing the issues as between the petitioner and Remington from the issues as between the peti- [fol. 420] tioner and the defendant International and providing for a separate trial of the latter issues;

2. A stipulation of facts on which the severed issue was to be tried; and

3. A stipulation between the petitioner and Remington providing, in effect, that any decree entered against Remington should be identic with the decree which might be entered against International after the trial of the severed issues between the petitioner and International.

These stipulations were all approved by Judge Knox, and the last two stipulations had annexed to them the proposed form of decree to be entered against the stipulating defendant in the event of a decision against International on the severed issues.

The result, therefore, of the situation created by these stipulations is that my decision on the severed issue will control the decree to be entered as between the petitioner and Remington as well as the decree to be entered as between the petitioner and International.

IV. The facts have been stipulated subject to the right of either side to object to the relevancy and materiality of some of the facts so stipulated.

[fol. 421] On November 18, 1935, pursuant to the rights so reserved, the petitioner filed objections to the facts regarding patents stated in sub-division M, of Paragraph 2 of the stipulation, as well as to copies of Letters Patent which were filed by International with the stipulation in pursuance of said sub-division, on the ground that in a proceeding under Section 3 of the Clayton Act the question whether the object leased is patented or unpatented is irrelvant and immaterial. I sustain this objection and hold that there is not any question of patent law, as such, involved in this cause.

So limiting the facts, I find them to be agreed as follows:

1. On or about June 1934, defendant The Tabulating Machine Company was merged with the defendant International, which acquired all the assets of The Tabulating Machine Company, including all leases of tabulating and related machines, and assumed all the liabilities of The Tabulating Machine Company, including those under its leases of tabulating and related machines.

2. Petitioner has for the past 30 years manufactured a very small number of tabulating machines with which tabulating cards are used, for use in the United States Bureau [fol. 422] of Census. These machines are manufactured for petitioner's own use and not for sale. They differ from those manufactured by the defendant and by Remington in that, while they are capable of performing certain of the functions performed by defendant's machines, they do not perform the variety of functions of which defendant's machines are capable.

3. Tabulating machines made by International are electrically operated; those made by Remington are mechanically operated; and both are used to perform tabulating, recording, calculating and statistical work. Used in connection with such tabulating machines are sorting machines, punches, and tabulating cards. Tabulating cards are small cards, generally printed, and so designed that perforation in them, according to their various locations or relative positions, indicate numerical or other data. Tabulating cards when inserted in an electrically operated tabulating machine are moved to a point in the machine where they come in contact with a large number of small electrical brushes. Said brushes, through the perforations

in the cards, establish electrical circuits, thus recording, tabulating, adding, computing, or otherwise registering the information denoted by the perforations in the cards. These machines pass the series of perforated cards over [fol. 423] the brushes at a speed of approximately 150 cards per minute. (Samples of said cards are attached hereto.)

In the mechanically operated tabulating machines of Remington, instead of brushes small pins move into the holes in the tabulating cards, this movement, through linkage, causing the recording, tabulating, calculating, etc.

Sorting machines of International are electrically operated and are used to separate, sort, or classify tabulating cards, according to the perforations in them, in order to segregate or classify all or part of the information represented by such perforations. Electrical contact through a particular perforation actuates the sorting machine in accordance with the location of the particular perforation. In the mechanically operated sorting machines of Remington, the movement of a pin into the perforation of a card, through linkage, causes the operation of the machine. The defendant's sorter operates at a speed of approximately 300 to 400 cards a minute.

Punches of International, operated by hand, mechanically, or electrically, are used to make the perforations in the tabulating cards.

[fol. 424] 4. All tabulating machines operated by holes in cards, and all punching machines and sorting machines used in connection therewith, which are now manufactured and available for commercial use in the United States are manufactured and leased (except some hand punching machines are sold) by the defendant or by Remington. They or their predecessors have made and now own substantially all of such tabulating machines which are being used in the United States by numerous business concerns, and by various departments, bureaus and administrative establishments of petitioner. Approximately 4303 tabulating machines, 4106 sorting machines and 8412 punches owned by International are now in use in the United States. Other than petitioner, the present users of such machines of International total 3303. International owns and leases approximately 85.7% of tabulating machines, 86.1% of such

sorting machines and 81.6% of such punches now in use in the United States.

5. Because of the increasing volume and complexity of the statistical data which the petitioner and many individuals, partnerships and corporations are required to assem- [fol. 425] ble, classify and tabulate, tabulating machines and related sorting and punching machines of defendant and Remington have become and now are a practical business necessity or advantage for the petitioner and for many such individuals, partnerships and corporations. There are some machines manufactured by others than the defendant and Remington which perform certain of the operations performed by defendant's tabulating machines, but there are no other machines (or combinations of other machines) available capable of performing without the intervention of additional manual operation the variety of functions performed by the tabulating machines of the defendant and Remington. Defendant's tabulating machines are commonly recognized to be superior in many ways to other machines which may be used for some of the same purposes.

6. The following business machines manufactured and sold by others than the defendant in this case and the manner in which they perform may be described as follows:

The Comptometer consists of a machine arranged with a key board and the operator in entering the amounts in this machine does so by the depression of the keys on the key board. This directly operates the adding wheels. When [fol. 426] a number of entries have been made the total of these entries is shown on the adding wheels and copied off by the operator.

The National Cash Register, 2000 Series Register, comprises a key board and a number of individual accumulators or totalizers. Entries are made of amounts by depressing amount keys on the key board and classification of entries into any particular totalizer or totalizers is controlled by their keys. The machine also includes listing and recording mechanism for recording on sheets or rolls of paper each of the items entered into the machine. Operation is effected by an electric motor controlled from the key board. After a number of entries have been entered, totals may be obtained of the entries into any particular totalizer. The machine may be arranged for debit and credit entries, and bookkeeping balances thereon.

The Burroughs Adding Machine is made in several types, ranging from simple non-listing adding machines to the more complicated bookkeeping and statement making machines. In its more complicated form, the machine comprises a key board which is manipulated, upon which different classes of entries of amounts are made by an operator. The machine can add and subtract these entries, print [fol. 427] the detail of the items, and obtain a series of printed totals. Such machines are widely used in various accounting practices.

The McBee Keysort is a hand operated device for rapidly sorting special cards into various classifications. These cards (which cannot be used in a tabulating machine) are provided with printed information placed upon them in any desired way and these cards are provided with a row of perforations around all of the edges, but spaced from the edge. When a particular classification is to be designated, a card is placed in a punch which notches out the card from the edge to the hole. These cards are then placed in a filing device and by inserting by hand a long pin in the holes corresponding to the one desired classification to be selected and by raising the pin, these cards may be segregated or sorted from the other cards which have not been notched. This system may be utilized in connection with other listing adding machines such as Burroughs, in order to make calculations based upon the segregated data.

The Underwood Elliott Fischer machines are of various types comprising comparatively simple listing adding machines of the ten key type wherein entries are made by depression of keys, amounts listed and totals added up [fol. 428] and total results printed on the tape. The more complicated forms of machines comprise a typewriting type of mechanism with which is associated calculating mechanism operated by the numeral keys of the typewriter. These machines are used for preparing statement forms of various sorts, recording lists or classified series of totals.

The Remington machines comprise punching machines, sorting machines and tabulating machines. These machines in general correspond to those of International, but in these machines action is mechanical, the power alone being supplied through electrical energy.

The Marchant Calculator is a calculating machine provided with a key board and an accumulating mechanism,

wherein the accumulating mechanism is movable with respect to the key board to facilitate multiplication and division. These machines are also capable of operation for a simple addition or subtraction. They are widely used in bookkeeping and statistical work or operations involving addition, subtraction, multiplication or division. In these machines the operation is wholly controlled by manually operable keys, but actual calculations are effected under power of an electric motor.

The Monroe Calculating machine in its general results is the same as the Marchant Calculator mentioned above. [fol. 429] In none of these machines, other than those of Remington, may a card be inserted therein and information be derived therefrom mechanically or electrically; nor data recorded on cards, by the making of perforations therein, for use with tabulating machines.

None of these machines, other than those of Remington, is capable (as are defendant's machines) of simultaneously segregating or accumulating any desired combination of miscellaneous numerical or other recorded data, and of performing calculating or tabulating functions with such segregated or accumulated data, without the intervention of any further manual key board manipulation.

7. International does not sell (and has not, during the past thirty years, sold) but only leases tabulating machines, including sorting machines and punches used in connection therewith (with the exception of hand operated punches, as distinguished from mechanically or electrically-operated punches, which said defendant does sell). The lease agreements ordinarily used by said defendant provide that (1) the company reserves title to the machines covered by the agreement; (2) the machine user acquires only the right to possess and a license to use said machines; (3) the machine user shall use in connection with said machines only tabulating cards manufactured by the [fol. 430] company; and (4) the machine user shall pay to the company a monthly rental. Said agreements provide that said defendant may forthwith resume possession of said machines if the user shall fail to observe the covenant to purchase tabulating cards for use in connection with said machines exclusively from said defendant.

8. Agreements for the use by petitioner of tabulating machines of International have not in all cases required

petitioner to use only tabulating cards manufactured by said defendant, but have sometimes provided that if petitioner shall use in said machines tabulating cards not purchased from or manufactured by said defendant, the monthly rental shall be increased in sums provided for in the various agreements with petitioner. Such increased rental has been approximately 15% of the rental otherwise fixed in such agreements. The additional sums in the form of rentals heretofore collected by said defendant from petitioner because of the use of cards not manufactured or purchased from said defendant have amounted to many thousands of dollars.

9. International has been for approximately thirty years and now is engaged in the business of manufacturing tabulating cards and in recent years has manufactured approximately 3,000,000,000 such cards annually. Said de- [fol. 431] fendant manufacturers 81% of all such cards manufactured. Of the cards manufactured and sold by said defendant, 28% constitute 45-column cards, 72% constitute 80-column cards; and 1.4% of all cards constitute 80-column cards which have been pre-punched, .3% of all cards constitute 45-column cards which have been pre-punched, and 4% constitute detachable record or stub cards. Except for such cards as are sold pre-punched, all cards sold by said defendant are punched by the users. An added charge is made for such pre-punching. The 45-column cards are designed for round holes, and the 80-column cards for rectangular holes. The 45-column cards and 90-column cards of Remington are designed for round holes.

10. International sells tabulating cards for use in connection with its machines. Purchasers of tabulating cards acquire title thereto and the cards do not become again the property of International. International and Remington are the only concerns now engaged in manufacturing and selling tabulating cards in the regular course of business in the United States, but the Public Printer manufactures [fol. 432] and sells tabulating cards to the various departments of the United States Government for use in the Government's machines and in machines leased from defendant and Remington.

11. International has earned a substantial profit on the manufacture and sale of tabulating cards, the gross

receipts derived from the sale of tabulating cards in the years 1926 to 1935, inclusive, being respectively, as follows:

1926	$2,613,000	1931	$3,444,000
1927	$2,633,000	1932	$2,775,000
1928	$2,887,000	1933	$2,841,000
1929	$3,595,000	1934	$3,392,000
1930	$3,947,000	1935 (9 mo.)	$2,850,000

12. It is possible for others than defendant to manufacture and sell satisfactory and usable tabulating cards. The manufacture of paper from which tabulating cards are made, is not the subject of Letters Patent or secret processes. Defendant does not restrict its paper stock suppliers in its relations with others.

13. Tabulating cards for use in defendant's machines must be of almost precisely accurate dimensions, and must be free of carbon spots, or slime spots, or irregularities of surface. A carbon spot in a card may cause an erroneous and unintended electrical contact, resulting in an erroneous sorting. The parts of the sorting machine are accurately coordinated to the card sizes, subject only to min- [fol. 433] ute tolerances. If the card is not accurate as to size or thickness within its tolerance, or if the perforation is not accurately punched within the dimensions of the card, or if the card contains carbon spots, or slime spots, or irregularities of surface, it may become erroneously sorted and may crumple, and clog the sorting machines.

Likewise, the parts of defendant's tabulating machines are accurately coordinated to the card size, subject only to minute tolerances. Each card is pushed down (from large numbers of other cards behind it and from the card immediately behind it and in contact with it) by a metal plate having at the top thereof a ridge of five one-thousandth 5/1000 of an inch projection. Each plate operates at a speed of 150 movements per minute. If any card is too thin, the result of the operation of this particular part of the machine may be that two cards will be drawn down and may clog at the next passage. Likewise, if any card is too thick or uneven in thickness, or with an irregular edge, it may crumple and clog the work. All machines may be adjusted for cards of different thicknesses within minute

tolerances; but if operated upon cards promiscuously arrayed, some of greater and some of lesser thickness, the [fol. 434] machines will not feed the cards or otherwise function.

The card in order to be properly located in the position it takes in relation to the electrical brushes in such tabulating machine and sorters must be accurately cut to dimensions; if too large it will clog; if too small or not cut at the proper angle the perforations will not be brought in contact with the proper electrical brushes; if the card contains carbon spots or metallic particles, unintended electrical contact may take place through the carbon spots or particles and register erroneous results. Improper surfacing of card, curl in the card, or slime spots in the card, may clog the operation of the machine or throw off the accuracy of the result.

14. When the card is passed across the electrical contacts its non-conducting character is necessary to prevent electrical contact through all save the perforations, and the operation of the tabulating machine is by virtue of the elimination of all electrical contact save the intended contacts through the perforations. Such electrical contacts through the perforations operate and control the mechanism

[fol. 435] in the statistical recording.

15. The card is not immediately destroyed in the sorting and other operations, but may be used over and over again, sorted to different perforations upon it, as required, and used with the machines, operating now through this and now through that perforation or series of perforations until worn out and may then be duplicated, through reproducing machines, for further use. Toughness and smoothness of surface, durability and stiffness are essential in a card for prolonged use.

16. The machines require for their operation a card especially manufactured. The cards used in tabulating machines have no other use, value or function, save for use in those machines.

17. There are no cards on the general market manufactured for other purposes which are appropriate for use in defendant's machines.

18. International sells time recording cards for use upon time recorders made by it and used generally by employers for recording the work hours of employees; also carbon paper, ink, ribbon and record sheets, and other such supplies for both time recorders and tabulating machines, but [fol. 436] makes no restriction or limitation upon its lessees or customers as to preventing them from obtaining such supplies upon a general market.

19. International manufactures its own cards, exercises particular care in the selection of paper stock, tests all paper stock with a speck detector (photographs attached and made a part hereof), which runs all the paper over fine electrical brushes, which, on any contact through the paper, operates cutting or marking machinery to ascertain and eliminate the defective part of the paper. The paper after being tested is then cut on machinery especially devised for the purpose and printed on machinery especially devised and adapted to the purpose.

The arrangement of the lines, figures and numbers on the card varies with the necessities of different customers or classes of customers so that card design and layout is a service ordinarily furnished by defendant to its customers in relation to the making of the card so that the perforations may be made in the appropriate locations for the segregation of the accounting and statistical data. This card design or layout (a service furnished by the defendant which is included in the price of the card) is made upon [fol. 437] a large sheet photographically reduced to proper proportions and then photo-engraved upon a printing cylinder.

20. In order to furnish such card design and layout service, International has gone to great expense in the maintenance of a school for the education of its salesmen.

21. During the last thirty years, the intricacy of International's machines, the speed at which they are run, and the functions they perform for lessees have much increased.

International's machines have always used cards of various sizes made of paper; and these cards have always been provided with perforations, have always permitted the closing of electrical circuits through the holes therein so as to cause tabulating, sorting, etc., and have always operated in timed sequence with the machines.

If a hole is either ahead of or behind its proper position (due to inaccuracy in card beyond co-ordinated tolerances of machine), the circuit will be established through the card hole at an instant which is out of time with the circuit breakers of the machine and out of time with other parts which the circuit is to control. This may produce an error [fol. 438] in the calculation or operation performed by the machines.

22. Satisfactory paper for the manufacture of tabulating cards is available other than from the source of supply from which defendant obtains the paper used in the manufacture of its tabulating cards. The United States Government Printing Office manufactures tabulating cards which have been found to be satisfactory, employing its own methods and machines and such cards are now being used in large quantities daily in the Government's machines and in machines leased by the Government from the defendant and Remington. Cards manufactured by Remington are mechanically satisfactory for use in the 45-column machines of International, but are not now electrically tested.

23. On August 15, 1927, George H. Carter, then Public Printer for the United States, made application to the Federal Trade Commission to institute a proceeding against International in respect of the clauses of its leases limiting the lessees to tabulating cards of its manufacture. After a preliminary investigation and an exparte hearing, at which only International, The Tabulating Machine Company and Remington were heard, the Commission declined to issue any complaint.

[fol. 439] I have, therefore, as the basis for my decision on the issues submitted to me, the pleadings, the agreed facts as here found relevant, and the inferences which I may properly draw therefrom.

V. Section 3 of the Clayton Act, so far as herein applicable, reads—in conveniently paragraphed form—as follows (italics mine):

"It shall be unlawful for any person engaged in commerce, in the course of such commerce, to lease * * * machinery * * *

"whether *patented or unpatented,* for use, * * * within the United States * * *, or fix a price charged therefor, or discount from, or rebate upon, such price.

"on the condition, agreement or understanding that the lessee * * * shall not use or deal in the goods, wares, merchandise, * * * supplies or other commodities of a competitor or competitors of the lessor * * *,

"where the effect of such lease, * * * or such condition, agreement or understanding may be

"to *substantially lessen competition*

"or *tend to create a monopoly* in any line of commerce."

VI. It seems to me that in order successfully to maintain herein a cause of action under Section 3 of the Clayton Act against International the petitioner should be required to show:

[fol. 440] That the leases of International's machines contained such restrictive clauses or covenants as are referred to in said Section, commonly called "tying clauses,"

That there has been or, now, but for such "tying clauses," would be competition in the particular commerce involved,

That the "tying clauses" of this defendant's leases have substantially lessened competition in such commerce, or

That said clauses have tended to create a monopoly therein.

In my opinion all these elements have been satisfactorily established by the petitioner in the instant cause.

A. Here the presence of the "tying clauses" in the leases is common ground.

Annexed to the stipulation of facts is a typical commercial lease used by International and also a typical lease between International's subsidiary The Tabulating Machine Company with the United States. Both leases, it should be stated, in order to make the phrasing of the quoted clauses clear, took the form of letters from the lessor, accepted by the lessees.

In the commercial lease the "tying clause" reads as follows (italics mine):

[fol. 441] "In consideration of the rental paid for the machines, together with the purchase of cards from this Corporation and the prices paid therefor, this Corporation hereby gives you a non-assignable license to use the above machines at the place and for the work aforesaid, but such license and any contract based upon the acceptance of this proposition shall be terminated forthwith by any failure to pay when due the aforesaid rental of the

machines, *or in case any cards that are not purchased from this Corporation are used in the operation of said machines.* In the event of such termination you agree to pay in addition to the rental already accrued, rental for the machines at the full rate for the remainder of the contract period covered by this agreement."

In the lease with the United States, the "tying clause" reads thus (italics mine):

"In consideration of the rental paid for the machines and conditioned upon the purchase of Tabulating Cards from this Company, as hereinafter specified, and the prices paid therefor, this Company hereby gives you a non-assignable license to use the above named machines at the place and for the work aforesaid, but such license and any contract based upon the acceptance of this proposition may be terminated forthwith by any failure to pay when due the aforesaid rental of the machines, except as hereinafter stated. In the event of such termination you agree to pay in addition to the rental already accrued, rental for the machines at the full rate for the remainder of the first year, or contract period covered by this agreement.

"The rentals hereinbefore stipulated are based upon the exclusive use, in any or all said machines, of cards purchased from the Tabulating Machine Company. In the event the Government requires the right to use in any of the said machines cards printed at the Government Printing Office, then you agree to pay a fifteen per cent increase in the rental of all leased machines covered by this agree-
[fol. 442] *ment, such increased rental to commence on the day upon which you first use or punch any government-made cards. In the event you resume the exclusive use of cards purchased from this company, the fifteen percent increase in rental shall be waived, such waiver commencing with the day upon which you start punching exclusively cards purchased from this company, and continuing so long as cards purchased from us exclusively are so used."*

B. The commerce here involved is the sale of unpatented tabulating cards. This is not inconsiderable, as the stipulation of facts shows, for the International alone makes and sells about three billion (3,000,000,000) cards a year. Almost all the cards are sold unpunched to International's

lessees and then punched by each lessee as desired for its particular form of sorting and tabulating.

It seems to me that, when the stipulation of facts is read against the background of the pleadings which includes the agreement of March 4, 1931, made between the International's wholly owned subsidiary and Remington, it is clear beyond any peradventure that Remington is a competitor of International in the commerce of selling tabulating cards.

That there was and in the absence of illegal agreements there again would be competition at least between International and Remington is implicit in the agreement of March 4, 1931, which is charged by the petitioner as a [fol. 443] violation of the Sherman Act, and which was canceled by the parties thereto after the commencement of this suit against them. If this were not so there would not be any reason for the provision in that contract, under the caption "Cards," that the parties thereto—

"severally agree to use their best and utmost endeavor to promote the sale of their respective cards to their respective users of punching, tabulating and/or sorting machines and not to promote (so far as they may lawfully do so) or to encourage directly or indirectly the sale to their respective lessees of cards manufactured by others."

And further that they—

"severally agree each for itself that it will not solicit business from any such user of the other party in the United States or Canada for cards, unless such user is a user of machines of both parties."

C. The question next to be determined is whether the maintenance of the "tying clauses" would substantially lessen competition in the sale of tabulating cards by excluding Remington as well as others from selling any tabulating cards, which it or they might make, to the lessees of International's punching, sorting and tabulating machines.

Under the provisions of Paragraph 2, subdivision W, of the stipulation of facts, I have had the advantage of a demonstration of the machines of International in connection with the argument of counsel therefor. I observed with [fol. 444] astonished interest the operation of a battery of International machines—its punch, its sorter and its tabulator, which are complementary to each other by reason of

the punched cards. I was shown a skeletonized model of the sorter and what is known as a plate model illustrating the operation of the tabulator. I was shown how the electric connections were made by the cards and I came to realize the necessity for accuracy in the punching of the cards in order that the necessary timing for the operation of the machine can be achieved.

There is no question but that, in a certain sense, as counsel for the defendant has said, the cards which are used in the machines are key boards to the sorter and the tabulator and, that, owing to the electrical operation of the International's machines, the cards must be approximately instruments of precision in order to ensure the necessary timing in their operation.

The argument of the defendant's counsel, however, seemed to me much to over emphasize the difficulty of making these cards sufficiently accurately to enable them to operate the defendant's machines correctly. For it is part of the stipulation of facts that the Public Printer for the United States has made tabulating cards which have been successfully used by the United States in the machines of the defendant, and I do not think that it can fairly be as- [fol. 445] sumed that it would be difficult for commercial competitors of International, especially such a competitor as Remington—with its experience in making tabulating cards for its own machines—successfully to make cards which would be properly tested to prevent unintended electrical contacts and would be accurate enough to operate International's machines.

The defendant has argued that the "tying clauses" in the leases involved a reasonable control of the commerce in cards, because the cards were in effect the key boards of the defendant's sorter and tabulator, and that the result of any defect in any card might be latent for a long time and lead to great possibilities of loss and annoyance to the lessees, and of difficulty in maintenance to International.

I do not think, however, that the test of whether Section 3 of the Clayton Act has been violated can be made to turn on the reasonableness of a "tying clause" from the point of view of the convenience of the lessor or, indeed, even from the point of view of the convenience of both the lessor and the lessee. The test to be applied must not be limited only

to the plane of their interests, but should be what might perhaps be aptly described as a three dimensional test; for the public must be considered and it must be determined [fol. 446] whether the "tying clauses" in question "substantially lessen competition" between the lessor and outsiders as possible sellers to the lessees of the article in question.

Indeed, the more I think about the defendant's argument the more I feel that it is merely an argument ab inconvenienti, which in its essence—stripped of all legal embroideries—could be addressed more effectively by the International's salesmen to International's lessees than by counsel for International to a court.

As to the practical result of a voiding of these "tying clauses", International's fears do not appeal to me. For if there is any real trouble in operation of its machines by its lessees with cards bought of outsiders, it is quite certain—owing to the relation between the cards and the machines—that, although after the "tying clauses" are voided, there may be at first some disloyalties, these disloyalties will be transitory and the lessees will soon be safe back in the fold again.

I think that it is obvious that even if there are no more than two competitors in a commerce of this kind, and each is allowed to bind the lessees of its machines from purchasing the tabulating cards of the other for use in its leased [fol. 447] machines, the competition in tabulating cards would almost certainly be not only substantially lessened but practically extinguished. Whereas if the "tying clauses" are voided in the leases of both competitors, the lessees of each will at least be able to purchase from either, and thus secure a better article or as good an article for a lower price.

D. It seems to me, also, that the maintenance of these "tying clauses" would tend to create a monopoly in the commerce involving tabulating cards, which, in their unpunched form, are admittedly entirely unpatented articles.

The defendant has, of course, a limited monopoly in respect of its machines by reason of the presumptive validity of its patents, though none of them has been adjudicated. To maintain the "tying clauses" would allow the defendant to "tend to create" an actual monopoly—beyond its proper patent monopoly—in what should be a free field of commerce. This is clearly denounced by the provisions of Sec-

tion 3 of the Clayton Act in its condemnation of "tying clauses" in connection with leases of patented articles.

With the "tying clauses" removed from the leases of both the International and Remington, it seems to me that there will be a clear field for competition; and for the ex- [fol. 448] ercise by the several lessees of the two Companies of free judgment in their purchases of tabulating cards. This—the Congress says—is as it should be.

VII. Accordingly, as the conclusion of law on the agreed facts, I hold that the "tying clauses" in International's leases are in violation of Section 3 of the Clayton Act and that the petitioner's prayer in respect thereof must be granted.

VIII. This opinion—limiting the agreed facts as I have limited them herein—will constitute the findings of fact and conclusions of law in this cause in respect of the issue which has come on for hearing before me.

An order to this effect may be entered on the usual notice. On account of the severance I think there should be a separate order in this regard instead of having it included, as is often done, as a provision of the final decree.

As to the final decree, I have the following comments to make:

In spite of the fact that the stipulations seem to provide for the entry of separate decrees in respect of the two remaining defendants, my suggestion is that, because this is [fol. 449] a single suit, the better practice would be for a single decree to be entered against them both.

I am quite prepared, however, to hear counsel on this point, if there is any reason why my suggestion is not wise or workable.

There will not be any costs granted to the petitioner.

Settle order above referred to, and the final decree or decrees to be entered herein, on notice, unless the form thereof is agreed.

December 2, 1935.

—— ——, United States District Judge.

[fol. 450] IN UNITED STATES DISTRICT COURT

[Title omitted]

ORDER CONSTITUTING OPINION AS FINDER OF FACT AND CONCLUSIONS OF LAW

The issues remaining in this cause under the stipulations between Petitioner and defendants, International Business Machines Corporation and Remington Rand, Inc., dated October 28, 1935, and approved by the Court November 12, 1935, having, under the stipulation for a severance of the issues and for a separate trial thereof as against defendants, International Business Machines Corporation and The Tabulating Machine Company, been submitted to the Court upon the pleadings and the stipulation of agreed facts herein and orally argued by counsel for Petitioner and for said defendants on November 20 to 22, 1935, and this Court, in an opinion dated December 2, 1935, having decided said issues in favor of Petitioner and against said defendant, International Business Machines Corporation, it is

Ordered that said opinion in this cause dated December 2, 1935, and the facts and conclusion of law set forth therein shall constitute the findings of fact and conclusions of law of the Court in this cause as to the defendant, Interna-
[fol. 451] tional Business Machines Corporation.

Dated New York, December 26, 1935.

Woolsey, United States District Judge.

[fol. 452] IN UNITED STATES DISTRICT COURT, SOUTHERN DISTRICT OF NEW YORK

In Equity. No. 66-215

UNITED STATES OF AMERICA, Petitioner,

against

INTERNATIONAL BUSINESS MACHINES CORPORATION, REMINGTON RAND, INC., The Tabulating Machine Company and Remington Rand Business Service, Inc., Defendants

FINAL DECREE—December 26, 1935

The United States of America having filed its petition herein on March 26, 1932, and each of the defendants having duly appeared by its solicitors,

And the defendant, International Business Machines Corporation, having entered into a stipulation with Petitioner, dated October 28, 1935, providing that the trial and determination of the issues in this cause as against the defendants, Remington Rand, Inc., and Remington Rand Business Service, Inc., might be severed and trial had separately as against defendants, International Business Machines Corporation and The Tabulating Machine Company;

And the defendants, International Business Machines Corporation and The Tabulating Machine Company, having entered into a stipulation with Petitioner, dated October 28, 1935, reciting the cancellation of the agreement dated March 4, 1931, between Tabulating Machine Company and Remington Rand, Inc. (Exhibit 1 attached to the petition), and that a consent decree as to the charges of violation of [fol. 453] the Sherman Act contained in the petition, in the form annexed thereto and identical with paragraph 2 hereof, might be entered against them upon the final determination of the remaining issues on the agreed facts set forth in said stipulation, irrespective of the outcome as to such remaining issues, and that the remaining issues in the case as between Petitioner and said defendants, International Business Machines Corporation and The Tabulating Machine Company, should be submitted to the Court for decision upon the pleadings and upon the agreed facts set forth in said stipulation;

And, pursuant to said stipulations, the issues remaining in this cause having been submitted to the Court upon the pleadings and the stipulation of agreed facts herein and orally argued by counsel for Petitioner and for said defendants on November 20 to 22, 1935, and this Court, having, on December 2, 1935, rendered its opinion deciding said issues in favor of Petitioner and against said defendant, International Business Machines Corporation, and concluding that Petitioner's prayer in respect to its allegations in the petition of violation of Section 3 of the Clayton Act must be granted; it is

Ordered, adjudged, and decreed:

1. That as used herein "tabulating machines" shall include tabulators and punches, punching machines, sorters and sorting machines or other machines used or to be used in connection with tabulating machines, tabulators or tabulating cards; and "tabulating cards" or "cards" shall

[fol. 454] include cards manufactured for use in connection with such machines;

2. That the defendant, International Business Machines Corporation, its officers, directors, agents and employees and all persons acting for or on behalf of them, or any of them, be and they are hereby perpetually enjoined from making, entering into, carrying out or enforcing any agreement or understanding, express or implied, with competitors dealing in tabulating machines—

(a) prohibiting or preventing said defendant from selling tabulating machines or offering such machines for sale, or

(b) fixing the prices, rentals, terms or conditions for or under which said defendant may sell, lease, rent, or otherwise license the use of tabulating machines, or sell or dispose of tabulating cards, or

(c) requiring said defendant to sell, lease, rent or license the use of tabulating machines only on condition that the lessee or licensee shall purchase or otherwise obtain, directly or indirectly, tabulating cards from said defendant, or

(d) requiring said defendant to incorporate as a condition of any contract of sale, lease, rental or license of tabulating machines that the purchaser, lessee, or licensee shall, because it obtains tabulating cards from any person [fol. 455] other than said defendant, pay the cost of, or any additional rental or charge for, repairs or maintenance, or

(e) restricting the freedom of said defendant to sell or encourage the sale or purchase of tabulating cards manufactured or sold by others, or

(f) restricting the freedom of said defendant to sell or dispose of its tabulating cards to users of tabulating machines other than those machines manufactured, sold, leased or licensed by itself;

3. That the "tying clauses" contained in the outstanding tabulating machine leases of defendant, International Business Machines Corporation, which require the lessees to use in connection with such machines only tabulating cards manufactured by said defendant, or which require the lessees to pay an increased rental for such machines, if

other cards are used in connection with them, are illegal, null and void, and in violation of Section 3 of the Act of Congress approved October 15, 1914, known as the Clayton Act.

4. That said defendant, International Business Machines Corporation, its officers, agents, directors and employees and all persons acting on behalf of them or any of them, be and they are hereby perpetually enjoined from incorporating as conditions in any contract of sale, lease, rental or license of any tabulating machine,

(a) provisions that the purchaser, lessee or licensee use in connection therewith tabulating cards manufactured or furnished by said defendant, or

[fol. 456] (b) provisions for a decreased rental or charge, or no charge, including service charges, on condition that the purchaser, lessee or licensee purchase tabulating cards from said defendant, or

(c) provisions for increased or additional rental or charge, including service charges, to be paid by the purchaser, lessee or licensee because of the use by such persons of cards which are not manufactured or furnished by said defendant;

5. That, within six (6) months after the entry of this decree, the defendant, International Business Machines Corporation, shall abrogate, cancel and declare to be null and void any and all provisions in every outstanding lease or license of a tabulating machine made by it which is hereby adjudged to be null and void, and shall thereupon furnish to each user of its tabulating machines a formal notice in writing of such abrogation and cancellation.

6. That jurisdiction is hereby expressly retained for the purpose of enforcing or modifying this decree on application of any party thereto.

Dated, New York, December 26, 1935.

Woolsey, United States District Judge.

[fol. 457] IN UNITED STATES DISTRICT COURT

[Title omitted]

NOTICE OF SUMMONS AND SEVERANCE

SIR:

Please take notice that the annexed petition for leave to appeal will be presented to the United States District Court for the Southern District of New York, at the office of the Clerk on the 9th day of January, 1936, at 3:30 p. m.; and that if you intend to join in the appeal of this defendant from the final decree herein, you will be required to present your petition for appeal at that time, or else this defendant will proceed as sole appellant.

Dated, New York, January 7, 1936.

Davies, Auerbach & Cornell, Attorneys for International Business Machines Corporation, Defendant Appellant, Office and Post Office Address: One Wall Street, Borough of Manhattan, City of New York.

To David L. Podell, Esq., Attorney for Remington Rand, Inc., 39 Broadway, New York, New York.

[Indorsed on back:] Copy received Jan. 7, 1936. David L. Podell, Atty. for Rem. Rand, Inc.

[fol. 458] IN UNITED STATES DISTRICT COURT

[Title omitted]

PETITION FOR APPEAL—Filed Jan. 15, 1936

To the Honorable the Judges of the United States District Court for the Southern District of New York:

International Business Machines Corporation, one of the defendants herein, conceiving itself aggrieved in the particulars set forth in the assignment of errors filed herewith, by a certain final decree of this Court made and entered the 26th day of December 1935, granting judgment for petitioner as therein set forth on the issues submitted to the Court, does hereby petition for the allowance of an

appeal from said decree to the Supreme Court of the United States, and prays that its appeal may be allowed and that a citation may be granted directed to the United States of America, commanding it to appear before the Supreme Court of the United States to do and receive that which may pertain to justice to be done in the premises, and that a transcript of the record of said proceedings duly authen-
[fol. 459] ticated, be transmitted to the Supreme Court of the United States.

Davies, Auerbach & Cornell, Attorneys for International Business Machines Corporation, Defendant Appellant, Office and Post Office Address: One Wall Street, Borough of Manhattan, City of New York.

ORDER ALLOWING APPEAL

Appeal allowed as prayed this 15th day of January, 1936. upon filing bond for costs in the sum of $250.

Wm. Bondy, United States District Judge.

[fol. 460] [File endorsement omitted]

Copy received Jan. 21, 1936. O. C., U. S. Attorney, S. D. N. Y.

Copy recd. Jan. 7, 1936. David L. Podell, Atty. for Rem. Rand, Inc.

[fol. 461] IN UNITED STATES DISTRICT COURT

[Title omitted]

ASSIGNMENT OF ERRORS—Filed Jan. 15, 1936

Defendant, International Business Machines Corporation, by Davies, Auerbach & Cornell, its attorneys, hereby files the following assignment of errors upon which it will rely in the prosecution of its appeal from the decree herein dated December 26, 1935:

1. The Court erred in directing judgment in favor of petitioner in respect of the issue tried before it.

2. The Court erred in not directing judgment in favor of the defendant in respect of the issue tried before it.

3. The Court erred in decreeing that the so-called "tying clauses" contained in defendant's outstanding leases of tabulating machines are illegal, null and void and in violation of Section 3 of the Clayton Act.

4. The Court erred in decreeing that provisions in defendant's leases of tabulating machines, requiring the lessees to pay an increased rental therefor in case cards manufactured by others are used in connection therewith, constituted a "tying clause" or violated Section 3 of the Clayton Act.

[fol. 462] 5. The Court erred in enjoining defendant from incorporating in its leases of tabulating machines, provisions that the lessee use in connection therewith, tabulating cards manufactured or furnished by it.

6. The Court erred in enjoining defendant from incorporating in its leases of tabulating machines, provisions for an adjustment of rental or charge, including service charges, in case of the use or refraining from use therewith of tabulating cards manufactured by others.

7. The Court erred in sustaining the objections of petitioner to the facts regarding patents stated in subdivision M of Paragraph 2 of the stipulation of facts, and to the copies of letters patent filed with such stipulation.

8. The Court erred in ruling that the question of whether the object leased is patented or unpatented is irrelevant and immaterial.

9. The Court erred in refusing to find that the tabulating cards were a component and operative part of the patented tabulating machines.

10. The Court erred in refusing to find that defendant was the owner of unexpired patents covering the tabulating machines, sorters and tabulating cards which are the subject of this suit, and the machines for manufacturing such tabulating cards.

11. The Court erred in finding that there has been or but for such so-called "tying clauses" would be competi-

tion in commerce in tabulating cards suitable for use in defendant's machines.

12. The Court erred in finding that defendant and Remington Rand, Inc. are competitors in the commerce of selling tabulating cards.

[fol. 463] 13. The Court erred in ruling that the so-called "tying clauses" have substantially lessened competition in commerce in tabulating cards.

14. The Court erred in holding that the effect on possible sellers who might make cards which would be properly tested constituted a substantial lessening of competition.

15. The Court erred in refusing to hold that the Government had failed to establish that there was a line of commerce affected by the so-called "tying clauses" in defendant's leases where there was no card on the market manufactured for other purposes which was appropriate for use in defendant's machines, where defendant's machines required a card specially manufactured and specially tested to prevent unintended electrical contact and where no cards were on the market manufactured by any other manufacturer which were thus electrically tested.

16. The Court erred in refusing to hold that the Government had failed to establish that there was a substantial lessening of competition where there was no card on the market manufactured by any other manufacturer thus electrically tested.

17. The Court erred in ruling that such so-called "tying clauses" have tended to create a monopoly in commerce in tabulating cards.

18. The Court erred in ruling that the so-called "tying clauses" are forbidden by the Clayton Act, even if they involved a reasonable control of an essential part of tabulating machines owned by this defendant.

19. The Court erred in ruling that the so-called "tying clauses" are forbidden by the Clayton Act even if the tabulating cards to which they relate form an essential component part of this defendant's patented tabulating machines.

[fol. 464] 20. The Court erred in refusing to hold that the so-called "tying clauses" constituted a reasonable control

of the use of defendant's patented tabulating machines, and that they were permissible under the provisions of the Clayton Act.

21. The Court erred in refusing to hold that the "tying clauses" constituted a reasonable control because, save for such "tying clauses", the cards would become in effect defective keyboards resulting in latent inaccuracy and hazard of great financial loss to all relying on the accuracy of the mechanical accounting.

22. The Court erred in refusing to find that the so-called "tying clauses" constituted a necessary protection of the good will of defendant and the reputation of its tabulating machines.

23. The Court erred in refusing to hold that the so-called "tying clauses" constituted a reasonable protection of defendant in performing its contractual duty toward its licensees to keep its leased machines always in repair.

24. The Court erred in refusing to hold that the so-called "tying clauses" with respect to the use of its cards by its licensees have not tended to substantially lessen competition or create a monopoly in tabulating machines or machines for mechanical accounting.

25. The Court erred in holding that there should be a free field of commerce in cards specially manufactured for use in defendant's machines where the accuracy of the machines in mechanical accountancy depended upon the accuracy of the card.

26. The Court erred in holding that the tabulating cards constituted "supplies or other commodities" within the meaning of Section 3 of the Clayton Act.

Wherefore, this defendant prays that the said decree of [fol. 465] the United States District Court for the Southern District of New York, dated December 26, 1935, be reversed and for such other and further relief as to the Court may seem just and proper.

Dated: New York, January —, 1936.

Davies, Auerbach & Cornell, Attorneys for defendant International Business Machines Corporation, Office & P. O. Address, One Wall Street, New York, New York.

[fol. 466] [File endorsement omitted.]

Copy Received Jan. 21, 1936. O. C., U. S. Attorney, S. D. N. Y.

[fols. 467-469] Citation, in usual form, showing service on United States Attorney, filed Jan. 22, 1936, omitted in printing.

[fol. 470] IN UNITED STATES DISTRICT COURT

[Title omitted]

EXTRACT FROM DOCKET ENTRIES

* * * * * * *

1936.

Jan. 15. Filed Petition and order allowing appeal—Bondy, J (Inter. Bus M Co.)
" " Assignment of Errors.
" " Bond $250.00 American Surety Co. of New York.
Jan. 21. " Praecipe for transcript of record.

A true copy.
Charles Weiser, Clerk. (Seal District Court of the United States, Southern District of N. Y.)

[fol. 471] IN UNITED STATES DISTRICT COURT

[Title omitted]

PRÆCIPE FOR TRANSCRIPT OF RECORD

To the Clerk of the above Court:

You are hereby requested to make a transcript of the record to be filed in the Supreme Court of the United States under an appeal in the above-entitled cause and to include among such transcript of record the following and no other papers and exhibits, to wit:

1. Petition of United States of America, verified March 4, 1932.

2. Answer of International Business Machines Corporation and of The Tabulating Machine Company, verified May 12, 1932.

3. Stipulation between Remington Rand, Inc. and Assistant Attorney General, dated October 28, 1935, together with proposed decree annexed thereto.

4. Stipulation, dated October 28, 1935 and approved by court November 12, 1935, for separate trial as against defendants International Business Machines Corporation and The Tabulating Machine Company.

5. Stipulation of facts between International Business [fol. 472] Machines Corporation and Assistant Attorney General, dated October 28, 1935, together with exhibits thereto as follows:

(a) Punched tabulating card;

(b) Form of agreement for tabulating machine service in the United States;

(c) Photostat of contract with United States Department of Agriculture for tabulating machine service, dated August 2, 1927;

(d) Form of consent provisions to be inserted in final decree;

(e) Photostatic copy of report showing total rentals, classified according to tabulators, sorters and punchers.

6. Statement of objections of United States of America, dated November 18, 1935, to portions of stipulation of facts.

7. Opinion of District Court, dated December 2, 1935.

8. Order, dated December 26, 1935, constituting opinion, findings of fact and conclusions of law.

9. Final decree, dated December 26, 1935.

10. Notice of summons and severance, and service thereon.

11. Petition for appeal and order allowing same.

12. Assignment of errors.

13. This præcipe and service thereon.

Said transcript is to be prepared as required by law and the rules of this Court and of the Supreme Court of the United States, and to be filed in the office of the Clerk of [fols. 473 & 474] the United States Supreme Court at Washington, on or before the — day of February, 1936.

Dated January —, 1936.

—— ——, Attorneys for Appellant.

Service of the above præcipe accepted and acknowledged this — day of January, 1936.

——— ———, United States Attorney.

[fol. 475] In United States District Court

[Title omitted]

Præcipe for Additional Transcript of Record

Sirs:

Please take notice that the Petitioner herein designates, in addition to the papers specified in the præcipe of the defendant, International Business Machines Corporation, filed herein January 21, 1936, on its appeal to the Supreme Court of the United States from the decree against it herein entered by this Court, December 26, 1935, the following as portions of the record in this cause to be incorporated into the transcript of the record on the appeal of said defendant, International Business Machines Corporation:

The following exhibits accompanying the stipulation of facts between International Business Machines Corporation and Assistant Attorney General, dated October 28, 1935 (and mentioned in paragraph "5" of the præcipe of defendant International Business Machines Corporation):

1. An unpunched 45-column tabulating card (printed).
2. An unpunched tabulating card (unprinted).
3. All patents filed with said stipulation.

[fols. 476 & 477] Dated January 27, 1936.

John Dickinson, Assistant Attorney General. Geo. P. Alt, Hammond E. Chaffetz, Special Assistants to the Attorney General.

To Davies, Auerbach & Cornell, Esqs., Solicitors for defendant, International Business Machines Corporation, 1 Wall St., New York, N. Y. Charles Weiser, Esq., Clerk, United States Distict Court, Southern District of New York.

Above counter-præcipe consented to.

Davies, Auerbach & Cornell, Solicitors for Appellant.

[fol. 478] IN UNITED STATES DISTRICT COURT

[Title omitted]

ORDER AS TO TRANSCRIPT OF RECORD—Filed Feb. 5, 1936

Defendant, International Business Machines Corporation having duly appealed by appeal allowed January 15, 1936, from the decree of this Court dated December 26, 1935, and having filed the bond for costs required by the order allowing said appeal, and having on January 21, 1936, served on the respondent and filed with the Clerk a præcipe indicating the portions of the record to be incorporated into the transcript of record on appeal; and respondent United States of America having on or about January 27, 1936, filed a counter præcipe indicating additional portions of the record to be included in said transcript of record, and appellant having consented to the inclusion of the portions indicated in said counter præcipe, it is hereby

Ordered, that the transcript of record on the appeal herein shall contain copies of the papers designated in the said præcipe and counter præcipe and no others.

Dated February 4th, 1936.

Francis G. Caffey, United States District Judge.

C. W.

[fol. 479] [File endorsement omitted.]

[fols. 480–482] IN UNITED STATES DISTRICT COURT

[Title omitted]

STIPULATION AS TO TRANSCRIPT OF RECORD

It is hereby stipulated by and between the parties to the appeal herein, that the foregoing is a correct and true transcript of the record of the said District Court in the above-entitled cause, as indicated in the præcipe and counter præcipe filed herein, and as settled by order of this Court, as the same remain of record and on file in the office of the Clerk of said Court.

Dated, February 11, 1936.

Davies, Auerbach & Cornell, Solicitors for Defendant-Appellant, International Business Machines Corporation. Hammond E. Chaffetz, Special Assistant to the Attorney General.

Clerk's certificate to foregoing transcript omitted in printing.

[fol. 483] SUPREME COURT OF THE UNITED STATES

STATEMENT OF POINTS TO BE RELIED ON AND DESIGNATION OF THE PARTS OF THE RECORD TO BE PRINTED—Filed Feb. 12, 1936

Comes now, International Business Machines Corporation, the appellant in the above-entitled cause, and adopts its assignments of error in full as its statement of points to be relied upon on this appeal, and states that the entire record as filed in this court, with the exception of the twenty (20) patents comprised in Exhibit (h) to the stipulation of facts, is deemed necessary to be printed for the consideration of the case.

Dated New York, N. Y. February 11, 1936.

Martin A. Schenck, Counsel for Appellant.

[fol. 484] Copy received Feb. 11, 1936. U. S. Attorney, S. D. N. Y.

[fol. 485] [File endorsement omitted.]

[fols. 486 & 487] IN SUPREME COURT OF THE UNITED STATES

APPELLEE'S DESIGNATION OF ADDITIONAL PARTS OF THE RECORD TO BE PRINTED—Filed Feb. 19, 1936

Pursuant to paragraph 9, of Rule 13 of the Rules of this Court, the appellee, the United States of America, hereby designates the following as additional parts of the record which are material and requests that the same be included in the printed record herein:

The twenty (20) letters patent filed with the stipulation of facts entered into herein between the United States and the International Business Machines Corporation dated October 28, 1935.

It is requested that only the heading, including all notations stamped thereon, and the drawings of the German

patent No. 367646, together with the filed translation of said patent, be printed (the translation being substituted for the German text thereof).

Dated February 17, 1936.

Stanley Reed, Solicitor General.

To Charles Elmore Cropley, Esq., Clerk, United States Supreme Court.

[fol. 488] [File endorsement omitted.]

Endorsed on cover: File No. 40,312. S. New York, D. C. U. S. Term No. 758. International Business Machines Corporation, appellant, vs. The United States of America. Filed February 12, 1936. Term No. 758, O. T., 1935.